SCIENCE

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*MEMORIAL ADDRESSES BEFORE THE SCIENTIFIC SOCIETIES OF WASHINGTON.**

JAMES DWIGHT DANA.

I HAVE a profound reverence and love for the memory of Dana. Nearly a quarter of a century ago, when I had returned from an exploring expedition in the plateau province, I prepared an article for the *Journal of Science* setting forth some of the characteristics of that land, especially the great blocks into which it is broken by faults and the tilting and wearing of these blocks into plateaus. In that article I characterized the faults, as such were then unknown. On sending the article Dana wrote me a long letter which led to a correspondence and an interview. The geology of arid lands is more easily read than that of humid lands, and Dana remonstrated with me about my conclusions, not deeming it possible to discover such faulting on an exploring expedition, especially as it is on a gigantic scale. Finally I visited him in New Haven, taking with me a series of sections, a body of notes and many photographs, all of which we discussed somewhat in detail. From that time Dana became my adviser and

* Given on January 14th, at a joint meeting of the Societies under the auspices of the joint commission. The address 'On Huxley and his Work' by Dr. Theo. Gill, and the address given the following evening by Dr. G. Brown Goode. 'A Memorial Appreciation of Charles Valentine Riley' will be printed in this journal.

friend, and I owe much to his wisdom and sympathetic assistance. It is thus that a feeling of gratitude impels me to render tribute to his genius.

Dana's time fell in America's first epoch of scientific research. There had been investigation in America before this time, but in the earlier part of the century there sprung up a group of scientific men born on the continent who took a prominent part in the creation of the world's stock of knowledge and who practically organized the scientific cult of America. In this brief account I cannot name all of these men, and yet I will mention ten as the leaders who, with a host of associates, inaugurated a movement which has vigorously grown to the present time and which will continue while civilization lasts. These great leaders were Henry, Logan, W. B. Rogers, Bache, H. D. Rogers, Gray, Hall, Dana, Leidy and Baird.

It must be remembered that the development of science is the work of many men, and that which one accomplishes is but a small integral part of the whole. But these men as leaders of the host established American science upon an enduring basis. The first phases of science are always ephemeral. Before scientific principles are wrought into a permanent form they must be rendered into philosophy. While many men gather the materials, the far-seeing few whose horizon is world-wide must ultimately be the master builders of philosophy.

Among the illustrious men whom I have mentioned, Dana was preëminently the philosopher. He was the man who formulated definitions, axioms and laws which are the fundamental elements of scientific philosophy. The facts must be gathered, and all honor to him who labors in the harvest field of science and adds to the inventory of significant facts; but the masters of science do more, for they organize the facts of science into a living philosophy. Science is not an architectural structure with foundation walls and dome; it is an organic living structure that develops by processes of metabolism. The facts are the constituents of the universal environment and the elements of which philosophy is constructed, and they pour into its living form to be assimilated, to play their part, and that which is perennial is the system of principles which includes all facts.

The life of James Dwight Dana exhibits a well-rounded half century of scientific investigation. For more than fifty years he was actively engaged in research, and for more than fifty years a stream of contributions to science issued from the wellspring of his genius.

For fifty years Dana was one of the editors of the *Journal of Science*, and during that time he was a constant contributor of articles on a wide range of topics, all involving original research. He was probably the best informed man in America in relation to the progress of science, and presented a resumé and criticism of research in many fields which was generous and appreciative on the one hand, far-seeing and profound on the other. Then for more than fifty years he was a professor in Yale College, conducting lectures, guiding classes and training men for scientific research, informing them with the spirit of investigation.

But his editorial and his professorial labors were the fruitage produced by the cultivation of many scientific fields. Instruction and review were always vitalized with research, and nothing came from his brain but living thought. The being of knowledge was transformed into the becoming of knowledge for himself and for the world. Dana was not only a professor and an editor, teaching and recording with wise guidance and profound appreciation, but he was also a zoölogist, a mineralogist and a geologist, and in each of these three realms of science a master. We learn that in his

youth, especially while pursuing his college course at Yale, he made a study of the plants of the region as a diligent botanist. This early study was a valuable preparation for his life's work, and its results were exhibited in the use which he made of plants in characterizing geologic periods.

In 1838 he sailed with the Wilkes expedition to explore the Pacific. This great voyage was over the mighty ocean to unknown lands of many climes, and for four years he was allured by strange sights, attracted by diverse objects of nature and thrust into the midst of a vast field of observation.

Here as a naturalist he engaged in the study of marine life, giving especial attention to the zoöphytes and crustacea, and laying the foundations of the knowledge of zoölogy which was afterward woven into the philosophy of the planet. The coral animals are animate builders of continental rocks, but he went beyond the structures which they built to study the builders themselves, their habits and the conditions under which they live. Out in those lonely seas, with savages for assistants, he studied the builders and their constructions, the animals and the atolls, the coral groves and the arboreal denizens, and returned with a vast accumulation of materials. Years were required for their elaboration. With patience this labor was performed, until at last he gave us an account of zoöphytes and also an account of the crustacea, which is in itself a monument worthy of a great man.

From his schoolboy days he pursued mineralogy as a field observer and by mathematical investigation. Early he commenced to publish on this subject, weaving the knowledge of his time into a systematic body, reënforcing his own observations by the observations of all others. Thus he was the first to give us a system of mineralogy; but his work in this field did not end at that stage. He still pursued his investigations, collecting from many fields and drafting from the collections of others in many lands, until at last he developed a new system of mineralogy, placing the science upon an enduring basis. This accomplishment alone was also worthy of a great man, and by it a new science was organized on a mathematical, chemical and physical basis.

Here we see exhibited the integrity of Dana's scientific character. In his first work on chemistry he adopted a system of nomenclature that involved a classification which then seemed to be in harmony with the practices of science, for he adopted a system analogous to that used in zoölogy which he advocated with acuteness, but further investigation revealed to him that his reasoning was wrong, that there was a more natural and scientific method, and he rent the whole fabric of his first work into shreds and rebuilt a new and better system. All honor to the man who can thus sacrifice his consistency to the truth.

While Dana was in the midst of his scientific work, Darwin announced the results of his investigations into the origin of living forms; it was a great stroke of genius. The doctrine which had been suggested and ably advocated by Lamarck was established by an inductive research in wide realms of botany and zoölogy, and new laws of evolution were discovered. But Dana had already propounded a doctrine of serial cephalization for animals, although not fully seizing the principles of evolution; still it was a long step in that direction, and he adjusted his philosophy to the new doctrine, and no great revolution was required. This was generously and thoroughly done.

We have seen Dana as a botanist, a zoölogist and a mineralogist. We are next to see him in the great work of his life, as a geologist. In 1833 he left Yale College, before graduation, to become an

instructor to midshipmen on a cruise in the Mediterranean. His first contribution to science was the result of observations made on this cruise; it is entitled 'On the Condition of Vesuvius in July, 1834.' At this early age, therefore, he began the study of volcanoes. While on the exploring expedition in the Pacific he visited the great volcanoes of the Hawaiian Islands. There is on the earth no other such region of fire as that first studied by Dana, and we may say last studied by him, for he revisited the region in his old age. Thus, on the exploring expedition he was introduced to two of the great geological agencies—vulcanism, the most conspicuous, and animal life, no less potent but less obtrusive.

On his return to the United States Dana resumed work in Yale College and continued field explorations in mineralogy and geology. The part of New England which he was led to explore is a region mainly of metamorphic rocks, and as a mineralogist he was especially equipped for such a field. It is also a region of glaciation, and he threw his energies into these two fields, which at that time were obscure. On the one hand he found glaciation interpreted simply as iceberg transportation, and on the other as a universal or almost universal ice period. These theories never led him astray, but with careful and persistent labor he unraveled the problem, and, perhaps more than any other man of his age, succeeded in putting glacial geology upon a sound basis. Equipped as a botanist, deeply versed in zoölogy and a great contributor to knowledge in that department, the leading mineralogist of the world, and no inferior chemist, the geology of the country became his theme, and with it the geology of the planet. At last he formulated a general system of geology, which has become the standard in America. His researches in the field were extensive, but they were reënforced by all the geological workers on the continent and the whole geological literature of Europe. So Dana's geology is not only a text-book of geology, but it is the hand-book for all National, State and local geologists, and all students in the field. It is the universal book of reference in that department of science. Other text-books have been developed, but no other hand-book for America. It is a vast repository of facts, but all arranged in such a manner as to constitute a system of geologic philosophy. It is on every worker's table and is carried in the kit of every field observer. It has thus become the standard to which all scientific research is referred, and on which geologic reports are modeled. Of the ten great men who organized science, five were geologists—Logan, the Rogers brothers, Dana and Hall, who yet remains with us. May he be long in the land!

Dana as a zoölogist was great, Dana as a mineralogist was greater, but Dana as a geologist was greatest, and Dana in all three was a philosopher, hence Dana's great work is enduring.

It thus came about that Dana wrought his work into a systematic body of science. The ruins of ancient towns and cities are widely scattered over all the earth, and the arts there entombed are disinterred as evidences of former culture, but we do not study ancient arts for the sake of imitating them; ancient art never becomes the model for modern art. The tribes and nations of antiquity are themes of investigation, but ancient institutions never become the models for modern institutions. Ancient languages are the themes of study, but never more will ancient languages become the models for modern languages. So ancient opinions are of profound interest, but ancient opinions will never again become the models for modern opinions. We study the past for the history of the past, not as a model to be imitated, but as exhibiting

the laws of culture, and by these laws learn to construct a better future. Thus we study the philosophy of the past, not that we may adopt that philosophy, but that we learn the laws of progress and avoid the errors of the past and construct a wiser future.

In the history of philosophy two lessons are plainly taught. The first is that no man can evolve an enduring philosophy from his own thought, but that philosophy must be evolved from facts, for the wrecks of such philosophies are scattered over the pages of thought from the time of Plato to the time of Hegel. The second great lesson is this, that the construction of an enduring philosophy is not the work of one mind, but of a multitude of men who gather their materials by scientific research. Since the days of Aristotle the wrecks of such attempts have strewn the highway of history. Even Descartes failed to do more than to make a contribution, while Newton and Darwin gave us but materials for philosophy, not philosophy itself. A host of men have engaged in this work collecting and organizing materials, and another host yet to live must carry on the work ere a scientific philosophy is developed, while the structures which have hitherto been developed mark but the stages of growth and those philosophies which have been wrought of pure thought; thought not informed by fact, are great lighthouses of warning to guide us from the rocks. It is thus as a philosopher of the scientific school that Dana's name will be remembered and Dana's contributions forever remain.

In a quiet street of the good old town of New Haven, Dana labored far from the turbulent crowd, absorbed in facts of observation and acquisition, loving and loved as only the quiet student can love and be loved. No pageantry marked his life, no glittering honors shed their luster over his career; he built only as the philosopher builds and he lived only as the philosopher lives.

The thoughts of early man are now unknown;
In all the tomes of world no page is his.
The grand phenomena of arching heaven,
The wondrous scenes of widespread earth and sea,
The pleasure sweet and bitter pain of life,
As these are known to-day so were they then,
But all in psychic terms of simple men.

And yet his thoughts live on to later time.
As mind has grown the thoughts have been enlarged,
Revolving oft in human soul through life,
In grand endeavor yet to reach the truth,
Repeated o'er by streams of countless men,
And changing e'er with mind's expanding view,
Till errors old have grown to science new.

With knowledge gained man never is content:
Nor wold, nor mount, nor gorge, nor icy field,
Nor depths of sea, nor heights of starry sky,
Can daunt his courage in this high emprise,
Or sate the vision of his longing eyes.

J. W. POWELL.

PASTEUR.

LADIES AND GENTLEMEN: I am to speak to you of the life and achievements of one who has won imperishable renown by his valuable contributions to human knowledge, and who has recently been buried in the city in which his scientific labors have been prosecuted, with all the honors which it was possible for a grateful people to confer. It is certainly a happy augury for the future when the man of science, whose achievements have been the result of painstaking and laborious work in the laboratory, receives the grateful plaudits of his fellowmen during his life time and the honors which were formerly only paid to civil potentates or military heroes when his body is committed to the tomb. It has been the fortune of few men to contribute so largely to the sum of useful knowledge, and fewer still have lived to receive such ample recognition of the value of their scientific work.

Pasteur's success has been due to a combination of personal qualities which especially fitted him for the pioneer work which

he has done in his chosen field of scientific investigation. With that penetrating intellect and versatility of resource which constitutes genius was combined an energy and persistence of purpose, a disregard of accepted theories not supported by evidence, and an appreciation of the value of the experimental method as the only reliable means of arriving at exact truth. No amount of conservative opposition intimidated him when he announced results obtained by his carefully conducted laboratory experiments, and no false pride seduced him into maintaining a position which he had once taken, if the experimental evidence was against him. This rarely haphened. But where is the man of science who is infallible? Working in a new field by methods largely of his own devising, which were necessarily more or less imperfect at the outset, it is surpising how few mistakes he made.

With his genius for scientific research, his indomitable perseverance and the forceful character which enabled him to defend his discoveries so successfully, there must have been associated a kindly disposition; for those who were closely associated with him in his laboratory work were devotedly attached to him. He evidently had the faculty of inspiring others with his enthusiasm for science, and their loyalty to him and to their common mistress was rewarded by the frank acknowledgement on his part of their share in the work accomplished. So far as I am aware, he never showed any disposition to appropriate for himself credit due to another, whether that other was an associate or pupil in his own laboratory or one who was prosecuting his investigations elsewhere. The speaker's personal acquaintance with Pasteur is limited to a memorable half day spent in his laboratory about ten years ago. Although still disabled to some extent by paralysis, resulting from his first apoplectic attack, he conducted m through his laboratory, and with the greatest kindness explained to me the methods in use and the results recently accomplished in the lines of experimental work which at that time occupied the attention of himself and his colleagues.

The time at my disposal will permit only a brief review of the life and work of this illustrious savant; but this review will show that his scientific achievements are of the highest order, and that the practical benefits resulting from his labors have extended to all parts of the civilized world. He belongs not alone to France, but to science, and it is eminently fitting that we should pay a tribute to his memory in this capital city of a country in which his name is so well known and in which the results of his scientific investigations are so highly appreciated.

Louis Pasteur was born at Dôle, a small town in the Department of Jura, France, on the 27th of December, 1822; he died at his home in Garches, a suburb of Paris, on the 28th of September of the past year.

Pasteur's father had been a soldier in the army of Napoleon, but at the time of his famous son's birth was working at his trade as a tanner. In 1825 the family moved to Arbois, a small town in the same department, and here Louis Pasteur attended school at the *collège communal*. Later he was sent to the college at Besançon, where he took his degree of the *Bachelier des Lettres*. He subsequently entered the École Normale of Paris, and while there devoted himto his favorite study—chemistry. Three years after joining the École Normale he was appointed Assistant Professor of Physical Science. In 1848 he was appointed Professor of Physics at Dijon, and after a few months resigned this position for the chair of chemistry in the University of Strassburg. In 1854 Pasteur was induced to accept the position of Dean of the newly created Faculty of Sciences at Lille; and in

1857 he returned to Paris as scientific director of the École Normale, where he had gained his first scientific laurels. In 1862 Pasteur became a member of the Institute and in the same year he was appointed Professor of Geology, Physics and Chemistry in the *École des Beaux Arts*. He was elected to the Academy of Sciences, taking the *fauteuil* of Littré in 1881. The same year he received the Grand Cross of the Legion of Honor. In 1874 the National Assembly of France voted him a life pension of 20,000 francs annually. Upon the anniversary of his 70th birthday, December 27, 1892, he received from his compatriots a superb ovation at the Sorbonne, which was attended by President Carnot, the members of the French Institute, all foreign ministers and ambassadors then at the French capital, and delegates from scientific societies in all parts of the world. The Pasteur Institute, established in his honor, was inaugurated with proper ceremonies on the 14th of November, 1888. It is situated in the *rue Dutot*, Paris, and is an imposing stone building in the style of Louis XIII. It was built and equipped from a fund raised by public subscription amounting to 2,586,000 francs. Of this sum 200,000 francs was voted by the French *Chambres Legislatif*. After the completion and equipment of the building more than 1,000,000 francs remained as a permanent endowment.

The time at my disposal will permit of but a brief review of Pasteur's scientific achivements. After having made some notable discoveries in chemistry his attention was attracted to the minute organisms found in fermenting liquids, and by a brilliant series of experiments he demonstrated the fact that the chemical changes attending fermentation are due to the microscopic plants known as bacteria; also that different species give rise to different kinds of fermentation, as shown by the different products evolved during the process. In prosecuting these studies he discovered the species which produce lactic acid, acetic acid and butyric acid, and he added largely to our knowledge relating to alcoholic fermentation and the class of microörganisms to which it is due. He showed that in the absence of living organisms no putrefaction or fermentation can occur in organic liquids, and that these low organisms do not develop by spontaneous generation, as was at that time generally believed, but have their origin from preëxisting cells of the same species, which are widely distributed in the atmosphere, especially near the surface of the earth. Various experimenters had shown that a development of bacteria sometimes occurs in boiled organic liquids excluded from the air. Pasteur showed that this was not due to spontaneous generation, but to the survival of the spores of certain species of bacteria; these are able to resist a boiling temperature without loss of vitality and reproductive power.

In 1865 the distinguished French chemist, Dumas, invited his former pupil, Pasteur, to make investigations with reference to the cause and prevention of a fatal malady among silkworms, which threatened to destroy the silk industry of France. In the course of an investigation which occupied several years, Pasteur succeeded in demonstrating the nature of the infectious malady known as *pébrine*, the mode of its transmission, and the measures necessary to eradicate it. Following his advice the growers of silkworms succeeded in banishing the scourge, and within a few years the industry was reëstablished upon its former profitable footing.

This pioneer work led to further investigations with reference to the cause and prevention of certain infectious diseases of the lower animals, and especially to the fatal disease of cattle and sheep known as anthrax. Having satisfied himself that this disease is due to a bacillus, which is found

in great numbers in the blood of infected animals, he demonstrated by experiment that this bacillus rapidly loses its virulence when cultivated in artificial media at a temperature of 42° to 43° C.; also that animals inoculated with this 'attenuated' virus suffer a mild attack of the disease, and that after their recovery they are immune against future attacks, even when inoculated with the most virulent material. This discovery has been applied practically, on an extensive scale, in France, Austria, Switzerland and other European countries. The result of anthrax inoculations made by Pasteur's method in France during the past twelve years was summarized by Chamberland in 1894. He reports the total number of animals inoculated during this period as 1,788,677 sheep and 200,962 cattle; and estimates the total saving as the result of the inoculations as 5,000,000 francs for sheep and 2,000,000 francs for cattle.

Another infectious disease in which Pasteur's method has been employed with success is *rouget*, or hog erysipelas. Chamberland states that, as a result of the protective inoculations practiced with Pasteur's 'vaccines,' the mortality from this disease in France has been reduced from about 20% to 1.45%. Hutyra reports that during a single year (1889) 48,637 pigs were inoculated with Pasteur's vaccines in Hungary with a loss of 0.29%, while the losses upon the same farms in previous years averaged from 10 to 30%.

But we must pass to that portion of Pasteur's scientific work which has most engaged the attention of the public. Pasteur first announced his success in reproducing hydrophobia in susceptible animals by inoculations of material obtained from the central nervous system, in a communication made to the Academy of Sciences on May 30, 1880. Continuing his investigations, he reported, in 1884, his success in conferring immunity against hydrophobia in 19 dogs inoculated, in the presence of a commission appointed for the purpose, as a test experiment. These animals had been rendered refractory by his method. The 19 protected animals and 19 control animals, obtained from the public pound without any selection, were tested at the same time. The test was made upon some of the animals of both series by inoculation with virulent material upon the surface of the brain, and upon others by allowing them to be bitten by rabid dogs, and upon still others by intravenous inoculations. Not one of the protected animals developed hydrophobia; on the other hand, three of the control animals out of six bitten by a mad dog developed the disease, five out of seven which received intravenous inoculations died of rabies, and five which were trephined and inoculated on the surface of the brain died of the same disease.

With reference to his first inoculations in man, Pasteur says:

"Making use of this method, I had already made fifty dogs of various races and ages immune to rabies, and had not met with a single failure, when, on the 6th of July, quite unexpectedly, three persons, residents of Alsace, presented themselves at my laboratory."

These persons were Theodore Vone, who had been bitten on the arm on July 4th; Joseph Meister, aged nine, bitten on the same day by the same rabid dog; and the mother of Meister, who had not been bitten. The child had been thrown down by the dog and bitten upon the hand, the legs and the thighs, in all in fourteen different places. Pasteur commenced the treatment at once, and had the satisfaction of reporting to the Academy of Sciences in March of the following year (1886) that the boy remained in perfect health. Since this time Pasteur Institutes for the treatment of hydrophobia have been established in all parts of the civilized world, and the statis-

tical reports published justify the belief that when the treatment is instituted at an early date after the bite, and is properly carried out, its protective value is almost absolute. At the Pasteur Institute in Paris 9,433 persons were treated during the years 1886 to 1890, inclusive. The total mortality from hydrophobia among those treated was considerably less than one per cent. (0.61). In 1890 416 persons were treated who had been bitten by animals proved to be rabid, and among these there was not a single death. In 1891 the number of inoculations was 1,539, with a mortality of 0.25%; in 1892, 1,790 with a mortality of 0.22%; in 1893, 1,648 with a mortality of 0.36%; in 1894, 1,387 with a mortality of 0.50%.

There has been and is still a considerable amount of scepticism among members of the medical profession, and others, as to the practical value of Pasteur's inoculations for the prevention of hydrophobia; and some physicians have even contended that the disease known by this name is not the result of infection from the bite of a rabid animal, but is a nervous affection due to fear. The time at my disposal will not permit me to present for your consideration the experimental and clinical evidence upon which I base the assertion that nothing in the domain of science is more thoroughly demonstrated than the fact that there is a specific infectious disease known to us as rabies, or hydrophobia, which may be communicated to man, or from one animal to another, by the bite of a rabid animal; and that Pasteur's inoculations prevent the development of the disease in animals which have been infected by the bite of a rabid animal or by inoculations with infectious material from the central nervous system. This being the case, it is evident that there is a scientific basis for Pasteur's method of prophylaxis as applied to man, and his published statistics give ample evidence of the success of the method as carried out at the Pasteur Institute in Paris and elsewhere. Great as have been the practical results which have already followed Pasteur's brilliant discoveries, there is reason to believe that in the future still more will be accomplished, especially in combatting the infectious diseases of man. Having pointed out the way, a multitude of earnest investigators in various parts of the world are now engaged in laboratory researches relating to the cause, prevention and cure of infectious diseases. Already, in the treatment of diphtheria and of tetanus with blood serum obtained from immune animals, results have been obtained of the highest importance, and it seems probable that in the near future other infectious diseases will be cured by a specific treatment based upon scientific information obtained by those who have been following in the pathway marked out by Pasteur, the illustrious pioneer in this line of research.

GEO. M. STERNBERG.

HELMHOLTZ.

HERMANN LUDWIG FERDINAND, BARON VON HELMHOLTZ, was born at Potsdam on August 31, 1821.

In 1842 he received his decree in medicine at Berlin, and entered the government service as an army surgeon.

In 1847 he published his essay on the Conservation of Energy.

In 1849 he was appointed professor of physiology at Bonn.

In 1851 he invented the Ophthalmoscope.

In 1855 he was made professor of anatomy and physiology at Bonn.

In 1859 he was appointed to the same chair at Heidelberg.

In 1860 he was made one of the foreign members of the Royal Society of London.

In 1863 he published his great work on the 'Sensations of Tone.'

In 1866 the first edition of his 'Physiological Optics' was completed.

In 1871 he was made professor of natural philosophy at the University of Berlin.

In 1873 he received from the Royal Society the highest distinction which it can bestow, the Copley Medal; and in the same year the King of Prussia conferred upon him the Order of Merit in Science and Art.

In 1883 hereditary nobility was conferred upon him by Emperor William I.

In 1887 he assumed the directorship of the great Physico-technical Institute, founded by the German government at Charlottenberg.

In 1891 the seventieth anniversary of his birth was celebrated with great ceremony and he was placed at the head of the civil list by the German Emperor.

In 1893 he visited America, serving as President of the International Electrical Congress held in Chicago.

In 1894, on September 8th, he died at the age of seventy-three years.

Such is the brief outline of the life of one of the most extraordinary men of the present century. To perfect such a sketch in anything like just proportions, or to attempt in the few minutes allotted to me to-night to set forth anything like a fair estimate of the labors of one of whom it may be justly said that he was the most accomplished scholar of modern times, is a task no one would seek. Nor can one easily decline the honor which is carried by an invitation from a commission representing the scientific societies of Washington to take part in so memorable a commemoration as this. Under the circumstances, I must confine myself to an exposition, all too brief, of a few only of the principal contributions to human knowledge among the great number for which the world is indebted to Prof. Helmholtz. It was his distinctive characteristic that among the exponents of modern science he stood quite alone in being really great along several lines. He was in the beginning and always a pure mathematician of high type. Anatomists and physiologists claimed him for their own. During a few days' stay in New York in 1893, after having presided over the International Congress of Electricians, he was entertained by a distinguished surgeon, the leading eye specialist of the country, and ophthalmologists flocked to do him honor as one of the founders of their profession. When, in 1881, he gave the Faraday lecture before the Chemical Society of London, the President of Society in presenting to him the Faraday Metal, declared that eminent as was Helmholtz as an anatomist, a physiologist, a physicist and a mathematician, he was distinctly claimed by the chemists. Nor were these only idle compliments. Only a few days ago I happened on a most curious and interesting illustration of the unequalled extent of his scientific constituency in finding, in a widely known journal published in London, his obituary notice indexed under the heading, 'The Stage and Music,' where his name appeared accompanied by only that of Anton Rubenstein. His great work on the 'Sensations of Tone' and his analysis of the vowel sounds of the human voice gave him a lasting fame among musicians.

Psychology as well as Æsthetics was benefitted by his touch, but I think it will be generally admitted that he was first of all, and more than all else, a physicist. Indeed it may be said that the best fruits of his study of other branches of science grew out of the skill with which he engrafted upon them the methods of investigation for which we are primarily indebted to the physicist.

When a boy he had acquired a fondness for the study of Nature. His father was a professor of literature in the gymnasium at Potsdam; his mother a woman of English descent. Although he was encouraged in the development of his youthful tastes as much as possible, the necessity for earning

a living directed his professional studies towards medicine and he became a military surgeon. As a physiologist he was led to the study of 'vital force'; his taste for mathematics and physics forced him to the dynamical point of view, and his first great paper, prepared before he was twenty-six years of age, was on the Conservation of Energy. It is now nearly fifty years since this essay was presented to the Physical Society of Berlin, and doubtless quite fifty years since it was actually worked out. Its excellence is shown by the fact that if rewritten to-day it would be changed only a little in its nomenclature. Fifty years ago the great law of the Conservation of Energy, which will ever be regarded as the most pregnant and far-reaching generalization of this century, was so far from being known or recognized that many of the ablest men of the time either regarded it as a 'fanciful speculation'—or did not regard it at all.

As a matter of ordinary mechanics, it had long been admitted that no machine could create power and, as a part of that applied was always lost or frittered away in friction, the work coming out of a machine must always be less than that put into it. The first great advance had been made by an American, Benjamin Thompson, afterwards Count Rumford, when he asked what became of that part lost in friction and found his answer in the heat generated thereby, thus proving that 'heat was a mode of motion,' 'rather than an imponderable agent,' as it was rather ambiguously designated up to nearly the middle of this century, but that *all* of the forces of nature were so related to each other as to be interconvertible and that the sum total of all the energies of the universe was always the same, energy being no more capable of creation or destruction than matter; these were great facts, mere glimpses of which had been permitted to the physicists of the early part of the century. Helmholtz was certainly one of the first to completely grasp this splendid generalization, and not more than two or three others stand with him in the credit which is due for its complete proof and general acceptance. His first contribution had the merit of being quite original in conception and execution, for he then knew almost nothing of what others had done; he was entirely ignorant of the important paper of his fellow countryman, Mayer, and knew only a little of Joule's earlier work. The principle of the conservation of energy, which for a quarter of a century has been the open-sesame to every important advance in physical science, was not then, to say the least, a popular topic. But for five or six years a young Englishman named Joule, not yet thirty years old, had been engaged with it and, from the point of view of the engineer, had made it his own. On the 28th of April, 1847, he gave a popular lecture in Manchester, where he lived and died, which was the first full exposition of the theory. A few weeks later Helmholtz read his paper in Berlin. In England even the local press refused to publish Joule's address, but finally the *Manchester Courier*, moved by the family influence (the elder Joule being a wealthy brewer), promised to insert the whole, as a special favor. In Germany the subject met with only a little more favorable reception, and the leading scientific journal, *Poggendorff's Annalen*, declined to publish Helmholtz's paper. Even at the meeting of the British Association at Oxford a few months after the Manchester address, when Joule again undertook the exposition of his theory and his experimental proofs of it, before what ought to have been a more friendly audience, he was advised by the Chairman to be brief, and no discussion of his paper was invited. As Joule himself relates, his presentation of the subject would have again proved a failure, 'if a young man had not risen in

the section and by his intelligent observations created a lively interest in the new theory.' This young man was William Thomson, then twenty-three years old; now, Lord Kelvin, the foremost of living physicists.

The tremendous blows struck by Helmholtz in support of the new doctrine, from that time until it was no longer in the balance give evidence alike of his extraordinary talents and his fine courage. The publication of this important essay in 1847 had also the effect of bringing about an immediate appreciation of his abilities. Du Bois-Reymond gave a copy of it to Tyndall, then a student of Magnus in Berlin, saying that it was the product of the first head in Europe. He was shortly removed to the more favorable environment of a University professorship at Königsburg. During the next twenty years he advanced from Königsburg to Bonn, from Bonn to Heidelberg and from Heidelberg to Berlin. While it was only on reaching the University of Berlin that he assumed his true function of Professor of Physics, yet the previous two decades had been rich in the application of physical methods to physiological subjects.

In 1863 He published the remarkable monograph on the 'Sensations of Tone.' This work is a most masterly analysis of the whole subject implied in its title and must always remain a classic. Only one or two of the most important results of the profound researches of the author can be referred to here. As every one knows, the character of a musical tone is threefold. There is first its pitch, which has long been known to depend upon the frequency of vibration of the string or reed, or whatever gives rise to the sound; there is next the loudness, which depends upon the amplitude of this variation, or, in a general way, on the energy expended by the vibrating body. But two tones may agree in pitch and in loudness and still produce very different impressions on the ear. It is this which makes it possible to know when a musical tone is heard that it comes from an organ, or a flute, or the human voice. It enables an expert to know on hearing a single note from a violin that the instrument was made in a given year by a certain artist; by virtue of this characteristic one instantly recognizes a voice which one has not heard for many years as belonging to a particular individual. So little was known of the physical cause of this inherent peculiarity of a sound that for many years it went unnamed. Helmholtz called it the 'Klangfarbe' literally, 'tone-color;' but in English the term 'quality' is now universally applied to it. What is the physical cause of the quality of a tone? is the question, the answer to which he sought. All that there is in a tone, he said, pitch, intensity and quality, must be borne upon the airwaves by which the sound is communicated to the ear, and all that these waves bear must be impressed upon them by the vibrating body in which the sound originates. He did not fail to recognize, however, and this was extremely important, that there might exist peculiarities in the receiving instrument, the ear (through the operation of whose mechanism the motion of matter is interpreted as a sensation), the existence of which would materially modify the final outcome, to the end that two physically identical tones might give rise, under certain circumstances, to different sensations. Guided by these principles he discovered that the quality of a tone, that characteristic which gives charm to it, was really due to its impurity; that if two perfectly pure tones, generated by simple, pendular vibrations, agreed in pitch and loudness it would be quite impossible to distinguish them. But, practically, such tones are never produced; all ordinary tones are composite, made up of the fundamental, which generally fixes the nominal pitch

of the whole, and a series, more or less complete and extended, of overtures or harmonics, the vibration frequencies of which are two, three, four or some other multiple of that of the fundamental. Without these, the fundamental, though pure, was plain, dull and insipid; with them it formed a composite with quality, soft it may be, or brilliant or rich or harsh, or any of the thousand things which may be said of a tone. *Which* it was and *what* it was, was determined by the relative proportions of the several overtones, indefinite in number, in the composite whole. This beautiful hypothesis was illustrated and established by innumerable experiments, and it was proved that the *form of the air wave* was the quality of the tone, and that this form originated in the mode of vibration of the sounding body, which was almost universally not simple, but complex. But the most important work of Helmholtz along this line was the extension of this theory to the solution of a problem more than two thousand years old, proposed, in fact, by the Greek, Pythagoras. It meant nothing less than the physical explanation of harmony. Why are certain combinations of musical tones agreeable and others unpleasant?—and, indeed, the answer to this tells as well, why a certain *succession* of tones, as in a musical scale, is likely to be generally acceptable to the human ear. Lack of time will only permit me to say that in the interference and consequent *beating* of certain of the overtones or upper partials, of two fundamentals, Helmholtz found the explanation of their dissonance, and that while in certain particulars his theory as originally published has been criticised, it is in general universally accepted and admitted to be one of the most splendid contributions to modern science.

I am warned, also, that I must not speak of that other great work, the Physiological Optics, as I would so gladly do if time permitted. Helmholtz was actually engaged in the preparation of this and the 'Sensations of Tone' during the same years. No other man in the world could have written these, for no other was at once an accomplished physiologist, mathematician and physicist. While I cannot speak of his contributions to the science of optics and ophthalmology, I must not omit brief reference to his invention of the ophthalmoscope and the ophthalmometer. Anxious to actually see what goes on in the eye, and especially on the retina, that wonderful screen on which the image of the visible world is focussed, he invented the ophthalmoscope. The qualitative victory was followed by the quantitative, in the invention of the ophthalmometer, by means of which accurate measurements of the various curved surfaces in the eye could be made. These two instruments have been to ophthalmic surgery what the telescope and graduated circle have been to astronomy. So exact has the science of the eye become through their use that it is not great exaggeration to say that one may now have a disordered eye repaired, corrected and set going with little more uncertainty than attends the performance of the same duty for an ill-conditioned chronometer. Had Helmholtz accomplished nothing except the invention of these instruments he would have been entitled to the thanks of all mankind, on account of the comfort they have added to life and the pain and suffering they have prevented.

If I had devoted all of the time allotted to me to a simple enumeration of the contributions to human knowledge made by von Helmholtz during fifty years of marvellous intellectual activity I must have left my task incomplete, but I must not close without reference to one or two of these, more purely physical in their character and equally stamped with the genius of their author.

Perhaps Nature has shown herself most reticent and unyielding when scientific men have questioned her as to the ultimate structure of matter, the full knowledge of which includes a satisfactory explanation of the force of gravity which is one of its essential properties. Hypotheses which have been very useful in their time have been finally rejected because they involved some impossible conception, such as action at a distance, which was for a long time believed possible. The tendency is now and has long been to regard space, or at least that part of it in which we have any particular interest, as a plenum and to assume a continuous, incompressible, frictionless elastic fluid in which and of which all things are. In the development of his exquisite theory of vortex motion, Helmholtz demonstrated the possibility of a portion of such a fluid being differentiated from the rest in virtue of a peculiar motion impressed upon it, and that when so differentiated it must forever remain so, a fact which was quickly seized upon by Lord Kelvin as the foundation of a vortex theory of matter, thus sharing with Helmholtz the honor of having approached nearer than all others to the solution of the great mystery.

From the genesis of an atom to the origin of the universe seems a long step, but it is not too great for the intellect of man. The well-known Nebular Hypothesis was advanced long before Helmholtz's time, but a better knowledge of Thermodynamics had quite upset one of its generally accepted principles, namely, that the original nebulous matter was fiery hot. As long ago as 1854 Helmholtz showed that this was not a necessary assumption and proved that mutual gravitation between the parts of the sun might have generated the heat to which its present high temperature is due. The greatest philosophers of the past hundred years have attempted to account for this high temperature and for its maintenance, on which all life on this globe depends. The simple dynamical theory of Helmholtz has survived all others and is to-day universally accepted.

But I must cut short this absolutely inadequate account of what the scholar did, that I may say a word or two of what the man was. Although one of the most modest and quiet of men, no one could meet him without feeling the charm of his personality. Although he bore a dignity which became the great master of science which he was everywhere admitted to be, he was approachable in an extraordinary degree. He was eloquent in popular address and believed in the obligations of men of science to the general public. In scientific discussion, whether on his feet or with pen in hand, there was a certain massiveness about his style and manner which was generally irresistible. In his attacks upon the region of the unknown he showed possibly less brilliant strategy than one or two of his contemporaries, but he rarely, if ever, found himself obliged to conduct a retreat. In 1893 he was selected by the Emperor as the head of the German delegation, five in number, to the International Electrical Congress held in Chicago in August of that year. His more than three score and ten years weighed upon him, and he begged to be relieved of the duty. The young Kaiser, who was fond of him and who loved to honor him in every way, sent for him. On hearing his modest plea he said, "Helmholtz, you must go; I want the Americans to see the best I have of every kind, and you are our greatest and best man." As becomes a dutiful subject he yielded. While in this country every honor was shown him. Here he found many of the hundreds or thousands of his pupils who everywhere in the world are adding lustre to his name by perpetuating his spirit and his methods, and all were ready to serve him. Electrician, mathematician, physiologist and physicist,

he found everywhere a large and appreciative constituency, while his own almost boyish pleasure in whatever he saw that was novel was charming to see. On his homeward voyage he met with an accident which was thought by many to be the beginning of the end. Up to the time of his death, which occurred about a year later, he continued, but not very actively, to direct the great institution for original research, in which, by the wisdom of an appreciative government, he had found full scope for his powers. His interest in the important work done at the Chicago Congress continued through this year, and one of the few long letters he wrote had reference to its proceedings. On the 8th of September, 1894, he died, and on the 13th he was buried at Charlottenberg, princes and peasants alike mourning his loss.

Von Helmholtz occupied so large a part of the scientific horizon and for so long a time that we have not yet become accustomed to his absence. But it is not too soon to agree that the following admirable lines which appeared in the *London Punch* a little more than a year ago express in some measure our judgment of the man and his work:

> "What matter titles? *Helmholtz* is a name
> That challenges alone the award of fame!
> When Emperors, Kings, Pretenders, shadows all,
> Leave not a dust-trace on our whirling ball,
> Thy work, oh grave-eyed searcher, shall endure,
> Unmarred by faction, from low passion pure."

T. C. MENDENHALL.

CURRENT NOTES ON PHYSIOGRAPHY.

THE TEMPERATURE OF LAKES.

A CAREFUL study of the temperature of lakes, leading to important economic results in connection with water supply, has lately been completed by Desmond Fitzgerald, of the Boston Water Works (Trans. Amer. Soc. Civil Engineers, xxxiv, 1895, 67–109). Many of the observations have been taken with the thermophone (see Amer. Meteorol. Journ., xii, 1895, 35–50), thus gaining much accuracy and saving much time. It appears from the numerous diagrams and tables in the essay, as well as from the text, that small water bodies, such as Lake Cochituate, one of the chief supplies for Boston, are generally in stable equilibrium. During the winter, when small lakes are frozen, the surface water to a depth of about ten feet is colder and lighter than the great body of deeper water whose temperature is that of maximum density. All through the summer, stability and stagnation again prevail, the surface water to a depth of thirty or forty feet being then warmer and lighter than the bottom water, which remains between 40° and 45°. During this summer period of stagnation, and after the oxygen dissolved in the water has been used in the decomposition of sinking organic substances, they accumulate for the remainder of the season; the water then becomes darker and darker, until by October it is very yellow and generally of a disagreeable smell. But in April, and again in November, the temperature of the lake is essentially constant from top to bottom; the water body is then in indifferent equilibrium and is easily overturned by the wind. In November particularly this overturning brings all the impure bottom water to the surface; infusoria and diatoms begin to grow in enormous numbers, because of the supply of food thus provided. While the degree of impurity of the stagnant bottom water varies in different lakes, it may in some become a serious annoyance; and it is suggested that, where possible, the bottom water should there be drawn off from reservoirs and 'wasted' before the November overturning arrives.

WINDS INJURIOUS TO VEGETATION AND CROPS.

UNDER the above title, the late Prof. Geo. E. Curtis contributed to the International

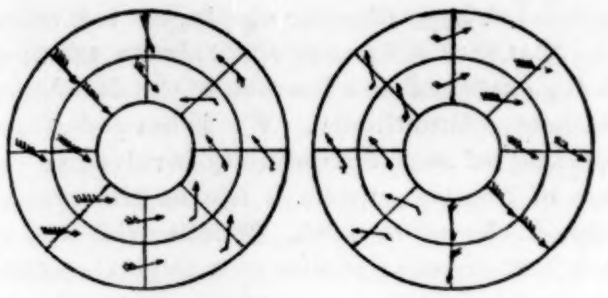
Meteorological Congress at Chicago in 1893 an essay lately published, with much other material in the second part of the report of the Congress, and issued as Bulletin II. of the United States Weather Bureau. Injurious winds are classified as violent, cold and desiccating. The first class includes the hurricane, the tornado and the thunder-squall (*derecho* of Hinrichs). The second class includes nocturnal winds, descending mountain valleys; these being quoted as injurious to the vine and limiting its area of cultivation in certain parts of Europe, but not yet known to be harmful in this country. Cold waves, blizzards and northers also belong in the second class. The deforestation of Michigan is said to have given more ready access to cold waves, hence 'the peach crop has nearly disappeared' from that State. The desiccating winds are more fully described, especially the hot southwest winds of the Plains, to which Curtis had previously given special attention (7th Bienn. Rept. Kansas State Board of Agriculture, 1891, 162–183; see also essay by Cline, Amer. Meteorol. Journ., xi, 1894, 175–186). The statistics of ten counties in Kansas in 1888 showed a loss of 21,000,000 bushels of corn alone, due principally to hot winds. These winds are chiefly of daytime occurrence, their temperature reaching over 100°, even to 109°, while their relative humidity is probably not over 20 or 25%. When the ground has been thoroughly dried, then one or two days of hot winds wither and shrivel up the crops beyond possibility of more than partial recovery. Destructive hot north winds occur in the valley of California. Timber belts are recommended as the best protection against both cold waves and hot winds.

DROUGHTS AND FAMINES IN INDIA.

JOHN ELIOT, of the Indian meteorological office, contributed a paper of much value to the Chicago Congress under the title given above. After a general account of the climate of India, in particular of the winds and rainfall, the author shows that the famine districts are all in areas of moderate or light rainfall, between 20 and 35 inches. One such area enters the southeastern coast of the peninsula and extends northwestward over the Deccan; another forms a V-shaped belt, pointing eastward and enclosing the arid desert area of the lower Indus. A late beginning of the rainy season, a prolonged break in its continuance, scanty rainfall during the period, or an early cessation of the rains, result in famine. In northern India famine is usually due either to the failure of two half-year crops in succession, to the complete failure of one crop after a succession of poor or bad seasons. In the Deccan famine follows a failure of the summer rains, after one or more bad seasons. A list of twenty-four famine years is given, beginning with 1769. Of these eight were 'intense famines,' while six were only 'severe scarcities.' The Orissa famine of 1865–66 caused a loss of life estimated at one million, out of three million population, and a loss to the State of £1,500,000. The Behar famine of 1873–4 caused an expenditure of £6,000,000, in providing relief to the distressed people; consequently the loss of life was small.

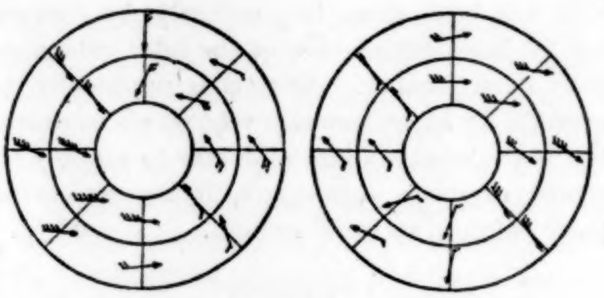
METEOROLOGICAL ELEMENTS IN CYCLONES AND ANTICYCLONES.

A VALUABLE study of the distribution of meteorological elements around areas of low and high pressure at Vienna and at Thorshavn, Sweden, has been made by Åkerblom (Svenska Vet.-Akad. Handl., xx., 1895, Bihang, No. 3). The diagrams for surface winds and for cirrus clouds are here reproduced. It is noticeable that while the cirrus clouds over a cyclonic area show but a moderate deflection to either side of their mean course from W. 6° S., those over an anticyclonic area are deflected



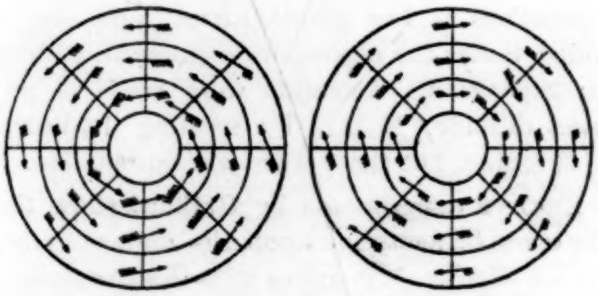
Min. Max.

Direction and Velocity of the Wind at Vienna. (Winter.)



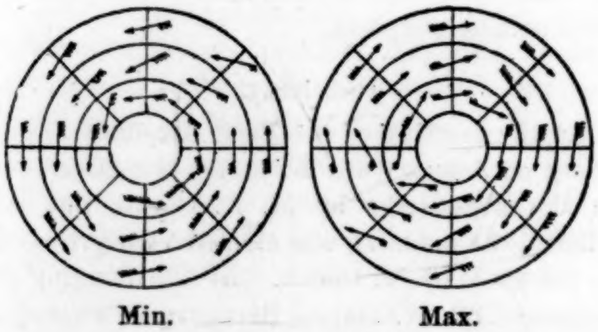
Min. Max.

Direction and Velocity of the Wind at Vienna. (Summer.)



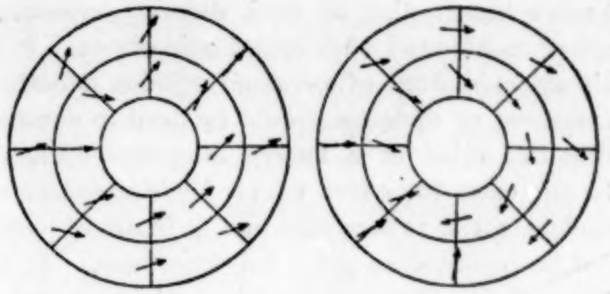
Min. Max.

Direction and Velocity of the Wind at Thorshavn. (Winter.)



Min. Max.

Direction and Velocity of the Wind at Thorshavn. (Summer.)



Min. Max.

Motions of Cirrus Clouds in Central Germany.

into a rather well marked right-handed whirl. It may be added that as far as the movement of the cirrus is concerned, it would suggest that inward baric gradients prevail aloft over cyclones and that outward gradients prevail over anticyclones, and that this is on the whole more favorable to the driven than to the convectional theory of atmospheric whirls in temperate latitudes.

W. M. DAVIS.

HARVARD UNIVERSITY.

SCIENTIFIC NOTES AND NEWS.

ASTRONOMY.

IN our issue of January 10th we called attention to Dr. See's announcement of a possible perturbation of the motion of the visible components of the binary star 70 Ophiuchi by an unseen companion. The *Astronomical Journal* of January 9th contains another article by Dr. See, in which he presents his views more at length and with much painstaking care. Yet after reading his elaborate paper, we cannot see that he has established anything more than a probability in favor of the existence of the supposed body. His strongest argument is, of course, the error of five degrees found by the American observers in Prof. Schur's ephemeris. But at the time of making his calculations Dr. See was unaware that nearly contemporaneous European observations were at variance with the American ones. If we take the mean of all the observations that have come to our knowledge we get a result in very fair accord with the ephemeris. Dr. See also bases a strong argument on the measures of distance, which were not used by Prof. Schur for the well-

known reason that all such distance measures are often affected with systematic errors. It is always a matter of personal opinion whether measures of distance should be used in computing the orbit of a binary like 70 Ophiuchi. In any case, the curve which Dr. See draws to illustrate the 'Perturbations in Distance' cannot be regarded as quite free from bias. Thus, if we divide the observations into three equal periods, we find:

Period.	Number of Points. Above See's Curve.	Below See's Curve.
1830 to 1850,	15	5
1850 to 1870,	13	7
1870 to 1590,	2	18

It is evident that the curve needs raising at one end and lowering at the other; and if this is done, it will come near admitting of a satisfactory representation by means of a straight line. However this may be, we wish to repeat our former statement that this star is certainly worthy of close attention from double-star observers. Dr. See's research serves to emphasize this fact very strongly.

IN the *Astronomical Journal* of January 23 Dr. S. C. Chandler publishes a paper on 'Standard systems of declination and proper motion,' in which he comes to the conclusion that "the system of the *Fundamental-Catalog*, admirable as it was for its original purpose, has now broken down, and the extension of its employment up to the present time, and certainly for the future, should cease." Dr. Chandler thinks that the proper system to use is that of Boss. To prove this he compares the declinations deduced by himself in a former paper from mural circle observations at Greenwich between the years 1825 and 1848 with the corresponding declinations from Boss' catalogue and from Auwers' *Fundamental-Catalog*. The agreement with Boss is much better than that with Auwers, especially after Boss has been corrected with a small term for latitude variation. We are unable to see in these facts a sufficient justification for Dr. Chandler's strong condemnation of Auwers' system. The essential requisite of a system of star places and proper motions is not that it shall differ from the truth at all epochs by the minimum amount. It is of no great consequence if the difference from the truth be somewhat large for some epochs, but it is essential that such difference shall always admit of being expressed as a function of the declination without discontinuity. We believe that the quantity of such discontinuity involved in the use of Auwers' system is less on the average than in the use of Boss'. Whether this be so or not is at present a matter of individual opinion, depending more or less upon the weight attached to Bradley's observations. But there is another practical essential of a star system which is not at all satisfied by Boss' system. We refer to the need of keeping the system up to date. This has been done very carefully by Auwers, but for Boss' system few of the later catalogues have been treated. Thus it is practically impossible for an astronomer who wants to deduce the best possible place of a star to employ the recent accurate catalogues, if he wishes the place referred to Boss' system. H. J.

CHEMISTRY.

LOBRY DE BRUYN has succeeded in preparing hydrazine or diamide, N_2H_4, in pure condition by treating the hydrochloric acid salt with sodium ethylate and distilling. The compound crystallizes at low temperatures, and can be boiled under the atmospheric pressure without decomposition. Attempts were made to prepare diimide, N_2H_2, by treating hydrazine with iodine, but these were without success.

RECENT experiments by Gréhaut show that the effect of acetyline upon the animal system is very slight. If it unites with the hæmoglobin of the blood at all, the compound is very unstable, and not to be compared with the compound of hæmoglobin with carbonic oxide. This fact is of special interest in view of the probable extensive introduction of acetyline for illuminating purposes.

GENERAL.

AT the meeting of the Paris Academy of Sciences on January 6th M. Marey was succeeded in the presidency by M. A. Cornu, and M. Chatin, the botanist, was elected Vice-President in the place of M. Cornu. At the meeting on January 13th M. Marcel Bertran was elected a member of the section of mineralogy, succeeding Pasteur.

THE Geological Society of London will this year award the following medals and funds: The Wollaston Medal to Professor E. Suess, the the Murchison Medal to Mr. T. Mellard Reade, the Lyell Medal to Mr. A. Smith Woodward, the proceeds of the Wollaston Fund and part of the Barlow-Jameson Fund to Mr. Alfred Harker, the proceeds of the Murchison Fund to Mr. Philip Lake, the proceeds of the Lyell Fund to Dr. W. F. Hume and Mr. W. C. Andrews, and the proceeds of the Barlow-Jameson Fund to Mr. Joseph Wright and Mr. John Storrie.

IT is reported in the daily papers that Prof. A. W. Wright and Prof. John Trowbridge have repeated Prof. Röntgen's experiments with the X-rays. A cablegram states that Prof. Mosetig, of the University of Vienna, has actually used the photography for diagnosis. The photographic pictures taken showed, with the greatest clearness and precision, the injuries caused by a revolver shot inthe left hand of a man and the position of the small projectile. In the other case, that of a girl, the position and nature of a malformation in the left foot were ascertained.

THE Bill for Adoption of the Metric System, introduced in the House of Representatives by Mr. Hurley (*not Harley*), to which reference was made in the last number of SCIENCE (January 31), has been considered by the Committee of Coinage Weights and Measures, and certain amendments have been suggested, to define more distinctly what is meant by the metric system, and to extend the time for the beginning of its general use to the first day of the next century.

MRS. ESTHER HERMANN has contributed $10,000 to the endowment of the New York Botanical Garden, making the total amount $260,000 in addition to plants of the value of $5,000 given by Mr. J. A. Pitcher.

THE Russian government is expected to introduce the Gregorian calendar in 1900. This may be done suddenly or by omitting the 29th of February in the first twelve leap years.

JOSEPH FIORELLI, an Italian antequarian and archæologist, died at Naples, on January 29th, at the age of 73.

THE catalogue of members of the American Institute of Electrical Engineers shows that on January 1st there were just 1,000 members, including two honorary members, Lord Kelvin and Mr. W. H. Preece.

THE *Journal of the Royal Statistical Society* has published the report of the committee of the Berne International Statistical Institute recommending that a universal census be taken at the beginning of 1900. The dates of the census in different countries do not now coincide, but it would be a great advantage to secure uniformity of date and also of methods, and the committee hopes to accomplish this.

MR. J. Y. BUCHANAN contributes to *Nature* for January 9th an interesting account of the capture of a sperm whale off the Azores witnessed by the Prince of Monaco. The animal, when dying, ejected the bodies of huge cuttle-fish which were secured, together with others subsequently found in the stomach. Owing to the absence of the heads it was impossible to positively identify them, but they probably represent a new species of *Histioteuthis* and of *Cucioteuthis*, and an entirely new genus and species to which the name of *Lepidoteuthis Grimaldii* is given by Prof Joubain. The largest cuttle-fish body was about two meters in length. Circular marks, believed to be the impression of suckers, were found on the head and body of the whale. This account corroborates the stories long told by whalemen who have always insisted that the sperm whale in his death agonies vomited up fragments of squids 'as big around as a barrel.'

AT a special meeting of the Chemical Society of London held recently, a memorial lecture on the 'Life and Work of the late Prof. von Helmholtz' was delivered by Prof. G. F. Fitzgerald, Trinity College, Dublin. It is perhaps not known to every one that Helmholtz was a great chemist as well as a great physicist, mathematician, physiologist and psychologist. He was a foreign member of the London Chemical Society, and in 1881 filled the office of Faraday Lecturer, when he communicated to the Society his famous memoir on the 'Connection between Electricity and Chemical Action."

THE *Zoologischen Adressbuch*, already noted in this journal, gives 2,458 addresses of zoölogists

in the United States, 1,703 in Germany, 1,523 in France, and 1,469 in Great Britain and Ireland. This is a satisfactory indication of the interest taken in zoölogy in America, even though it may have happened that a larger percentage of collectors and amateurs are included in the case of the United States than in the cases of the other countries.

MR. C. E. BORCHGREVINK arrived in New York on February 2d, and will lecture in America.

ALFRED L. KENNEDY, metallurgist and geologist, was burned to death through a fire in his room on January 30th. He was about 80 years of age.

THE Montreal Branch of the British Medical Association have invited the Association to meet in Montreal this year. This invitation cannot be accepted as arrangements have already been made to meet in Carlisle, but it is probable that the Medical Association will before long follow the example of the British Association for the Advancement of Science and hold a meeting in Canada.

ACETYLENE gas seems hitherto to have been promoted chiefly with a view to selling stocks and franchises, though we understand the process is not covered by patents. It seems, however, probable that the gas will have important practical applications, which shows once more the practical importance often following chemical research. Acetylene gas is a hydrocarbon compound resulting when water is added to calcic carbon, which is made by fusing lime and carbon in an electric furnace. The only commercial acetylene is now made at Spray, N. C., but it is reported that a furnace is being erected at Niagara Falls, and that large quantities of the gas will soon be manufactured. The advantages of the gas are its brilliant white light, ten to twenty times as great as coal gas, its portability and (it is claimed) its cheapness. It should be remembered, however, that it is poisonous, and, especially in certain compounds, explosive.

AN editorial article in the February number of *Appleton's Popular Science Monthly* on 'The Hundredth Anniversary of the French Institute' states that "As yet, the name of no citizen of the United States has been inscribed on the roll of the foreign associates of the Institute, although it is understood that in a recent election to fill the vacancy occasioned by the death of a member the name of Prof. Simon Newcomb, of Washington, lacked but a few votes of receiving this honor." Prof. Newcomb was elected an associate member on the 17th of June of last year, succeeding von Helmholtz, as announced at the time in this journal. The name of Prof. H. A. Rowland should be added to the list of American correspondents given in *Appleton's Popular Science Monthly*. The six American correspondents are: Asaph Hall, B. A. Gould, S. P. Langley, H. A. Rowland, James Hall and A. Agassiz.

JOHN WILEY & SONS announce for July next a volume on *Higher Mathematics for Engineering Colleges*, edited by Prof. Mansfield Merriman and Prof. R. S. Woodward. The work is intended primarily for the use of Junior and Senior Classes in schools of engineering, and contains a concise treatment of subjects not commonly found in text-books, but upon which lectures are now given in the best classical and technical institutions. In addition to chapters by the editors on the Solution of Equations, and Probabilities and Theory of Errors, the work will contain the following chapters: Prof. W. E. Byerly, of Harvard University, Harmonic Functions; Prof. T. S. Fiske, of Columbia College, General Theory of Functions; Prof. G. B. Halsted, of University of Texas, Projective Geometry; Prof. E. W. Hyde, of University of Cincinnati, Point Analysis and Ausdehnungslehre; Prof. W. W. Johnson, of U. S. Naval Academy, Differential Equations; Prof. A. Macfarlane, of Lehigh University, Vector Analysis and Quaternions; Prof. J. McMahon, of Cornell University, Hyperbolic Trigonometry; Prof. F. Morley, of Haverford College, Elliptic Integrals and Functions; Prof. D. E. Smith, of Michigan Normal School, History of Modern Mathematics; Prof. L. G. Weld, of University of Iowa, Determinants.

MACMILLAN & Co. announce a work on 'Social Interpretations of the Principles of Mental Development,' by Prof. J. Mark Baldwin, of

Princeton, and 'An Outline of Psychology,' by Prof. E. B. Titchener, of Cornell University.

DR. DONALDSON SMITH gave before the Royal Institution, London, on January 20th, an account of his expedition to Lake Rudolf, in northeastern Africa. It was found that the Nianann is the only river emptying into the lake, and that there is no river Bass, as supposed by Count Teleki. Seven hundred birds were collected, and of these 24 have been described by Dr. Bowdler Sharpe as being new to science. The different species of insects numbered 3,000, and besides these there were many plants, butterflies and mammals collected.

A HEARING was given on January 30th by the Commissioners of the District of Columbia upon a Senate bill which would prevent vivisection in the District. Dr. Busey and Surgeon General Sternberg spoke against the bill.

MEMBERS of the Gypsy Moth Commission of the Massachusetts State Board of Agriculture appeared before the Committee of Agriculture and argued in favor of the passage of an appropriation of $200,000 for the work of exterminating the gypsy moth. It was stated by director E. H. Forbush that 425 men would be needed during the spring and summer; it is proposed to burn over infested waste lands which is done by means of a machine which throws out a spray of oil which burns so rapidly that the eggs and caterpillars are destroyed without injury to the trees, then the trees are burlapped and examined, and eggs laid during the season are so far as possible destroyed. Roads would be examined with special care to prevent caterpillars from dropping on passing teams and being thus carried to uninfested localities.

UNIVERSITY AND EDUCATIONAL NEWS.

AT a meeting of the convocation of the University of London on January 21st a resolution was passed, 460 votes being in its favor and 240 against it, favoring what is known as the Cowper Commission Scheme for the consolidation and reconstruction, of the examining and teaching institutions of London. It should be remembered that the University of London does not give instruction, but only grants degrees on examination, whereas there are also in London two or more colleges which give instruction but do not grant degrees. It is universally admitted that some reform is needed, either that the teaching institutions should be consolidated and permitted to confer degrees on their students, while the University of London remains purely an examining body, or that all the institutions should be united. As appears from the above vote, the members of the convocation of the University of London attending the meeting favored the latter plan, but it is claimed that it would not have the approval of a majority of all the graduates.

A PUBLIC meeting has been held in Albany urging the removal of Union University from Schenectady to that city, and it is understood that the matter will be seriously considered by the trustees.

MR. JOSEPH BANNIGAN has given $4,000 to the Catholic University of America, and has made known his intention to donate for twelve years $4,000 a year for library purposes.

BY the will of the late Mrs. Doyon, the University of Wisconsin has received $5,000, the income of which is to be devoted to scholarships for young women.

Two scholarships of $2,000 each have been presented to Tufts College, one by Mrs. A. B. Perkins and the other by J. S. and H. N. White.

DR. L. TRENCHARD MORE, of St. Louis, Mo., has become an assistant in physics at the Worcester Polytechnic Institute.

DISCUSSION AND CORRESPONDENCE.

THE INVERTED IMAGE ON THE RETINA.

EDITOR OF SCIENCE: Prof. Brooks can hardly hope that there should be any consensus among scientific men in regard to the difficult question whether we know or do not know whether the lower animals have or have not consciousness, if there are still distinguished scientists who think that there is anything which needs explanation in the fact that the image on the retina is inverted, or that the question will continue to be a subject for discussion for centuries yet to come. As long as we do not *feel* that the image on the retina is inverted, as long as we are not aware in consciousness that

there is an image or a retina, however much we may have formed the one and dissected the other, it makes no difference whether the image is inverted or not. With a proper distribution of nerve ends we could get on perfectly well with a three-dimensional image formed in the vitreous humor in the interior of the globe of the eye—what was once supposed to be the scheme of vision, a scheme which would have had the immense advantage of saving us a lot of thinking in the effort to understand how we see out- and in-ness. We could also get on perfectly well if the flat image which is actually produced were broken up into a thousand parts, and the parts distributed upon the retina in any confused order whatever, provided the order were a perfectly fixed one, and provided also (possibly) that the eyes were immovable in the socket.

While we are not conscious of the image nor the retina, we are conscious of the movement of the eye in the socket. With the present arrangement, when we reach the hand upward to touch an object, we also move the eye upward to fixate it, that is, the front half of the ball of the eye, which is the part we are familiar with on account of seeing its motion in other individuals and in our own mirror. If the image were not inverted and we had to move the eye to the left at the same moment that we move the hand to the right, there would then be something to be explained, though this incongruity would doubtless be perfectly overcome by experience.*

I touched my little girl of eleven with a pencil point on one corner of her eye and asked her what she saw. "I see a round whitish spot over there," she said. "Is it not strange," said I, "that when I touch you on the right, you see something on the left?" "No," she said, "I do not think it is strange at all." What, said I to myself, Prof. Le Conte is then right, and all the psychologists are wrong—this child is aware that rays of light cross within her crystalline lens, and that when she sees an object on the left it is because her retina has suffered an affection on the right, in spite of the fact that she has never heard of retina or of crystalline lens? But on questioning her farther I found that this was not the case. She had formed a rapid hypothesis to account for the otherwise unintelligible fact, namely, that the pressure of the pencil was communicated straight across the eyeball and affected it on the opposite side. It had not entered into her mind to conceive that a sensation on the right was not due to something going on in the right hand half of her eye, and she had no intuitive idea of projection through a point.

The psychologist's view is thus summed up by Professor James (*Principles of Psychology*, II., 42): "I conclude then that there is no truth in the 'eccentric projection' theory. It is due to the confused assumption that the bodily processes which cause a sensation must also be its seat. It is from this confused assumption that the time-honored riddle comes of how, with an upside-down picture on the retina, we can see things right side up. Our consciousness is *naïvely* supposed to inhabit the picture and to feel the picture's position as related to other objects of space. But the truth is that the picture is non-existent, either as a habitat or as anything else, for immediate consciousness. Our notion of it is an enormously late conception. * * * Berkeley long ago made this matter perfectly clear (see his Essay towards a New Theory of Vision, §§ 93–98, 113–118)."

Külpe, in his *Outlines of Psychology*, has attached himself to the position of James and Stumpf (and James mentions Professor Le Conte as one of the two or three writers who have given him most aid and comfort in supporting his position) to the effect that retinal impressions are from the first endowed with a spatial quality, in opposition to Helmholtz and others, who regard visual space sensation as purely a system of signs for effecting a one-to-one correspondence with tactual space sensation. To Professor James' argument, which is already inexpugnable, Külpe adds the testimony of a

*If the eyeball be moved up and down by the finger, objects looked at seem to move also. Prof. James has suggested that some one try the experiment of moving the eye in this way for many hours at a time, and he predicts that here also experience would have her perfect work, and that in time this apparent motion of objects would no longer take place.

fact of pathology, which by itself would be enough to settle the question—the rare cases, namely, of metamorphopsia. It sometimes happens that a piece of the retina is detached by means of a wound, and that it afterwards grows on again in a wrong position, and vision is regained, but things are out of place. A case has just been reported before the Italian Ophthalmological Society, in which distorted vision occurred over the portion of the retina affected, the inversion being from right to left, but not also up and down (showing, therefore, in addition, that the retina can still perform its function when it is wrong side out). Such cases as this are also plainly incompatible with a projection theory. C. L. F.

BALTIMORE, MD.

MARSH GAS UNDER ICE.

PROF. REMSEN'S note under the above title in SCIENCE for January 24th, p. 133, is of more than local interest. So far as I am aware, the phenomenon of gas spurts through ice has not before been described. As early as the winter of 1878–'79 the writer observed, at West Summit, N. J., the ice on a bog covered with miniature craters and mounds of new ice. These ice accumulations took place about vents up through which came water and gas bubbles, the former charged with the brick-red ferruginous deposit at the bottom of the bog. Frequently the vent was along the side of a blade of bog grass. During the winter, the surface of the ice on the bog become very rough by the additions made in this way. The flocculated bog ore thus brought to the surface was, during times of rain and thaw, washed into the neighboring stream, so that the process tends to retard the growth of bog ore deposit. Similar outbursts may be observed during the winter where a coating of ice forms over a lawn which has been treated with ordinary manure in the autumn. Gas spurts break out after a period of continued cold, and the surface of the ice becomes discolored with the products urged up by the escaping gas. An instance of this action was to be seen on the grounds of the Museum of Comparative Zoölogy at Cambridge last winter. It would be of some importance in glaciology to ascertain what part this escape of gas plays in the breaking-up of the ice on shallow ponds and lakes. J. B. WOODWORTH.

CAMBRIDGE, MASS., January 27, 1896.

ETHNO-BOTANIC GARDENS.

THE purposes of a museum are twofold: First, it is to be a place of instruction where the general public can resort for information as to objects from distant or foreign lands; second, it is to be a place for scientific research. A museum fulfills its purpose best when both of these objects are kept in view. The collections should be so arranged as to teach the public by object lessons, and at the same time be adapted for scientific work. Most of our colleges have kept these objects prominent in the fore front, and many of them have arranged synoptical collections for the instruction and edification of visitors. Several of the larger institutions of learning, notably Harvard and the University of Pennsylvania, have buildings set aside for museum purposes, and it is, therefore, to them that we must turn when we desire to study the operation of museums with educational views and aims.

The University of Pennsylvania proposes to erect, in the near future, a series of museum buildings, which will bring the institution into closer touch with the general public, and at the same time give the students in the several departments a chance for original research work. It is intended by the University authorities to place the buildings in a public park to afford better light for exhibition purposes, and so as to display to better advantage the architecture of the structures. A separate building it is planned will be devoted to archæology and ethnology. Such a building is badly needed at present, for the anthropological collections in general have accumulated to such an extent as to crowd the space in the library now allotted to them.

The opportunity is presented when these buildings are erected to construct an ethnobotanic garden in connection with the public park. It is to the outlining of the purposes of such ethno-botanic gardens, in general, that this article is directed.

1. Only aboriginal American plants should find a place in such a garden. No plant can be found more graceful than maize, a grass asso-

ciated with the myths of the aboriginal races of America, and worthy to be our National emblem. This plant has been little thought of for decorative purposes in our gardens; yet, it is decidedly ornamental and worthy of esteem. The sunflower, too, ought to be grown. The Indian recognized its value, for the Moquis and Ava-Supais planted it for food, and used the ground seed mixed with corn meal as a dainty. Several travelers have described the plant as grown by the inhabitants of the far Southwest. Tobacco should not be forgotten. The European owes much to this weed, nor is he the only one who enjoys it, for the Redman from the earliest time smoked the pipe of peace and, as the wind wafted the smoke upward, offered significantly a prayer to the Great Spirit. The tomato with its crimson fruit, the pumpkin vine, the bean and the potato should find their place as vegetables of aboriginal use in some corner of the garden. The oak, yielding acorns; the willow, dye stuffs, can be placed to good advantage near the pond in which grow Wah-es-i-ping, *Sagittaria variabilis Engelm*; yellow lotus, *Nelumbium luteum* L.—both furnishing aboriginal root esculents; water cress, *Nasturtium*, a salad plant, and wild rice, *Zizania aquatica*, L.

A partial list will show the large number of 'Indian' plants which a gardener could use:

Nymphæa odorata, L.	*Physalis grandiflora.*
Nuphar advena, Ait.	*Diospyros virginiana, L.*
Prunus virginiana.	*Plantago major, L.*
Fragaria sp.	*Betula papyrifera, Marsh.*
Amelanchier Canadensis, Torr. & Gr.	*Thuja occidentalis, L.*
Ribes hirtellum, Mx.	*Pinus monophylla, Torr. & Frem.*
Larrea Mexicana, Moric.	*Juglans nigra, L.*
Apios tuberosa, Ph.	*Acorus calamus, L.*
Celastrus scandens, L.	*Typha latifolia, L.*
Cornus Canadensis, L.	*Scirpus lacustris, L.*
Chiogenes hispidula, Torr. & Gr.	*Lilium superbum, L.*
	Oryzopsis membranacea.
Vaccinium.	*Phragmites communis, Trin.*
Ledum palustre, Ait.	
Aralia nudicaulis, L.	*Zea mays, L.*

2. The plants should be arranged with reference to the Indian tribes which used them. The plants of the Algonquins should stand apart from those of the Iroquois; those of the Aztecs from those of the Pueblos. Such a geographical arrangement is most desirable for educational purposes.

3. An arrangement according to the uses of the plants ought also be made. The strictly agricultural plants, such as corn, beans, potatoes and pumpkins, ought to be sown in one bed, the fibre plants, like basswood, *Tilia Americana, L.;* spruce, *Picea;* sumach, *Rhus aromatica;* willow, *Salix lasiandra, Benth;* unicorn plant, *Martynia proboscidea, Glox;* tree yucca, *Yucca brevifolia, Engelm;* ash, *Fraxinus*, in another; the dye plants, as alder, *Alnus incana, Willd;* celandine, *Chelidonium majus, L.;* smart weed, *Polygonum Hydropiper;* poke, *Phytolacca decandra, L.*, *Coptis trifolia, Salisb.*, in another.

The myth plants and medicine plants also are important as showing the culture of the aborigines. They by no means should be excluded from the garden.

The educational purposes of such an ethnobotanic garden have so far been discussed. The question may arise: What is the scientific value of such a garden? It is this: Frequently in studying the articles manufactured from plants by the Indians, it is difficult to determine what plant was used in each particular case. A histologic study of the vegetal tissues will give sometimes a clue, and if the microscopic structure of the manufactured article be compared with the fresh plant an identification is in many cases possible. To cite a case, the writer was asked not long since to identify the plant forms found on certain Central American tablets.* He was almost certain that the leaf found at the base of the cross, in the celebrated Tablet of the Cross, was that of the tobacco. The Herbarium specimens of the genus *Nicotiana* were examined, but showed very imperfectly the auricles at the base of the leaf which were so plainly marked in the conventionalized sculptured form. Had he had the plant growing somewhere, the identification could easily have been made, certain garden forms of tobacco, which he afterwards saw, showing the auriculate base clearly.

*See a paper of mine on the subject, Plant Forms on Mexican and Central American Tablets. American Antiquarian, XVI., 299, September, 1894, in connection with the ¶ on the Tablet of the Cross.

There can be no doubt, therefore, that such an ethno-botanic garden would stimulate greatly the interest in aboriginal plants, and at the same time it would be of the greatest scientific value. Nothing of the kind has ever been attempted along the lines suggested above, and such a garden would soon become a Mecca for those who desire to write monographs upon our American plants and their uses among the aborigines.

J. W. HARSHBERGER.
UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC LITERATURE.

Certain Sand Mounds of Florida: By CLARENCE B. MOORE.

I have elsewhere* called attention to the important work which Mr. Moore is doing toward the elucidation of the archæology of Florida, a research to which he has given his personal attention for several years. The third memoir† on this subject contains the results of his field work from January 16th to June 16th, 1895.

Mr. Moore has now examined with great care nearly all the earthworks of the St. Johns and Ocklawaha valleys. Of this large number only two were erected after white contact. That is, in only two were found objects obtained from the whites and placed with the original interments in the mounds. In several instances glass beads and other manufactures of the whites were found on or near the surface of a mound, or with intrusive burials of recent times; and Mr. Moore shows how easily such recent things might be taken as evidence of recent origin of the mound in which they are found. It is only by such thorough work as Mr. Moore is doing that our American archæology is advanced, and it is therefore with a feeling of satisfaction that we read the account of his careful field work and follow the true archæologist from page to page as he patiently describes each mound and its contents, and notes the position of every skeleton and object described.

The author of these memoirs takes the field fully equipped for the thorough prosecution of this work, and employs from twenty to forty laborers under experienced guidance. He also prints and illustrates his papers in a handsome manner. The objects are well illustrated, nearly always of natural size, and, what is greatly to be commended, the artistic desire of the draughtsman to make them look a little better than the originals is not apparent here. The explorer in several instances states that he did not take to his collection in Philadelphia such and such potsherds or other fragmentary objects because he had many perfect specimens of the same type. This is to be regretted since every archæologist is not so fortunate as he, and the very potsherds which he discards would be treasured in many a museum, particularly as Mr. Moore's work in the field is so thorough that nothing is left for another in the same region. Even this regret is tempered when we know how liberal Mr. Moore has been in supplying several museums with representative collections from these Florida mounds.

It is yet too soon to draw conclusions as to the peopling of Florida or as to the time when these burial mounds were first formed. Wyman showed by his research that many of the shell mounds of the St. Johns were of great antiquity, and that there were certainly two and probably three phases in the life of the people who formed them. From Mr. Moore's explorations, it seems likely that the sand mounds—as old as many of them unquestionably are—belong to the later period of the shell mounds, and in a few instances come down to the time of European contact.

One of the questions not yet fully answered is that of the relation of the early people of Florida with other tribes. We know that among the most recent were the mixed people known as the Seminoles. We also know that Florida was inhabited in very early times, as shown by the discoveries of Pourtalés and later by Heilprin. We can now trace by the artifacts brought to light in the burial

* The Harvard Graduate Magazine of June, 1895.

† Certain Sand Mounds of Duval County, Florida; two mounds on Murphy Island, Florida; and certain Sand Mounds of the Ocklawaha River, Florida. By Clarence B. Moore. Journal of the Academy of Natural Sciences of Philadelphia, Vol. X., 1895, 4to, 108 pages. 91 illustrations in the text; two maps; 16 plates of pottery and a frontispiece illustrating a large conical mound.

mounds that there must have been a widely extended trade with tribes of the interior, and possibly a migration from the central portion of the continent to Florida. The large number of copper objects found by Mr. Moore, many of the same character and in some cases identical with those found in the Ohio mounds, is evidence of contact. The copper itself, which probably came from the Lake Superior region, is an important factor in this connection. The skulls found in the Florida mounds are of the brachycephalic type, closely resembling those from other southern mounds. The pottery, however, is different to a marked degree. The stone 'celts' or hatchets are distinctly of the extreme southern type, bordering on the West Indian. Is there Carib infusion from the islands or from the northern coast of South America? There are indications in this direction.

The oldest perfect skull known from Florida is extremely dolichocephalic and entirely different from the mound type. This was found by Wyman at the bottom of the great shell heap near Hawkingsville on the St. Johns. This heap was so old that its lower layers of the shells had become decomposed and transformed into a limestone in which this skull and other bones of the skeleton are firmly imbedded. We naturally question if this skeleton is not that of a survivor of the earlier people who were on the peninsula before the short-heads came.

Thus there is a complicated problem which can be solved only by such careful field work as was begun by the late Jeffries Wyman and is now being continued by Mr. Moore. In this connection it is interesting to know that Mr. Frank H. Cushing is now engaged in explorations on the west coast of Florida, under the auspices of the archæological department of the University of Pennsylvania.

Mr. Moore in this last memoir has described and figured a number of vessels and singular objects of pottery, which he designates as 'mortuary' and 'freak' pottery. This pottery, to which I called attention in my notice of his first and second memoirs, is, thus far, peculiar to these Florida mounds. The forms he designates as 'freaks' are very odd and are apparently, useless for any practical purpose. Perhaps *ceremonial* would be a better designation, since we know that among other peoples pottery of a certain character was made for ceremonial purposes, and that such vessels were often placed with the dead. That mortuary vessels were sometimes made for this special purpose is indicated by the fact that holes were purposely made in many of the vessels before they were subjected to burning or baking; while vessels of utility were sometimes perforated or even broken into several pieces before being placed in the mound. Among some tribes the breaking of a vessel or an implement is to 'kill' it, that its spirit may accompany the spirit of the dead person; and some such idea may have prevailed here. This would be another indication of the culture of the people coming from the west, which would agree with other facts pointing to such a migration of the southern brachycephali. It is also interesting to note here the resemblance in this respect to the mortuary customs of some of the peoples in Europe in ancient times who made special vessels of pottery for burial with the dead, and even manufactured them with holes in the bottom the same as was done in Florida. Is this simply a psychical coincidence in the development of culture in places so widely separated, or is it an indication of man's migration in early times?

On page 74 Mr. Moore gives an illustration of a little piece of pointed and oxidized iron, less than an inch long, which in itself seems insignificant. This fragment would have been overlooked by a less careful observer or would perhaps have been taken for the end of a nail and so put down as proof that the mound was made after European contact. Mr. Moore himself thinks that it must be carefully considered from this point of view, while at the same time he suggests that it may be of meteoric origin. To me this bit of iron is most significant, for it closely resembles several small awls or piercers I have found in the Ohio mounds, some of which were so well preserved as to furnish the proof that they are made of meteoric iron. In 1882 I was puzzled by a mass of iron rust and fragments of iron found during the exploration of the great group of mounds known as the Turner group in Anderson county, Ohio, where

Dr. Metz and I carried on a ten years' exploration for the Peabody Museum. The finding of this iron at first seemed to prove that the builders of the mound must have been in contact with Europeans, and yet I knew that every indication of great antiquity was present. Tree growth, formation of soil over the mounds, and the formation of limonite by infiltration, were among these evidences. Still here was iron in considerable quantities, and it became an important question as to its origin. A piece was cleaned for analysis and nickel was shown to be present. Then a mass weighing 37 ounces was cut, and the section showed crystals of olivine as well as the nickel. Soon we found we had ornaments and implements made of the same material. These were all made by hammering the metal in the same way as similar ornaments and implements were made of copper. Thus we proved that this ancient people had found masses of meteoric or native iron, and had used it the same as they did native copper. Since then I have identified ornaments and fragments from certainly three distinct meteorites in our explorations of Ohio mounds in widely separated parts of the State. Among the implements are small axes, chisels and awls or piercers. Some of the latter so closely resemble this piece found by Mr. Moore, particularly in its flaky oxidation, as to strongly suggest that the object is purely of native make from a piece of meteoric iron. I may mention here that native copper, native silver, native gold and native or meteoric iron were found together on one altar in the Turner group in Ohio, and also implements and ornaments made from these metals. In this connection I will again call the attention of archæologists to the important contribution on the sources of native copper given in the second of this series of memoirs by Mr. Moore. In this he has shown that the copper objects from the mounds were made of *native* copper. He has thus confirmed the views of those archæologists who have denied the European origin of the copper.

For many other interesting points relating to the art and culture of the people who buried their dead in these Florida mounds, I must refer the reader to these instructive memoirs. I am pleased to state that Mr. Moore is at the present time continuing his researches in Florida, and we shall undoubtedly soon welcome another paper from him giving the results of this winter's work. F. W. PUTNAM.

PEABODY MUSEUM, HARVARD UNIVERSITY.

The Dispersal of Shells. An inquiry into the means of dispersal possessed by fresh-water and land Mollusca. By HARRY WALLIS KEW, F. Z. S., with a preface by ALFRED RUSSEL WALLACE, LL.D., F. R. S., etc. With illustrations. London, Kegan Paul, Trench, Trübner & Co., Ltd. 1893.

Although this little book has been published for some time, the subject is one of perennial interest, as naturalists will continue to gather facts bearing upon it. Though at first sight a rather limited field of inquiry, the author treats of it in a fairly comprehensive way, the chapters discussing the anomalies in local distribution, means of dispersal of fresh-water and of land shells, transplantation of bivalves and of univalves, the tenacity of life of land shells, the dispersal of slugs, the dispersal of fresh-water and land mollusca by man, the ninth and last chapter dealing with the fresh-water and land mollusca introduced into the British Isles by human agency.

The book will be of value to American conchologists and field naturalists, as it is by no means of local interest.

Of a curious nature are the facts collected by the author relating to the transportation of fresh water bivalves by insects, batrachians and birds, with the figures in illustration.

We see nothing special to criticise, nor are we aware of any omissions, except two which it would have been well for the author to have mentioned. The first is the introduction, by probably human agency, of *Helix hortensis* at different points on our northern coast, although it is not clearly proven that the species is not indigenous, yet this does not seem to us probable. Binney concludes that it has been undoubtedly imported to this continent.

In Gould's illustrated report on the invertebrata of Massachusetts, edited by Binney, this species is said to be "An European species introduced by commerce (?) to the northeastern portion of North America. It is found on

islands along the coast from Newfoundland to Cape Cod, and on the mainland plentifully, in Gaspé, C. E.; also along the St. Lawrence." It also inhabits Greenland, but Vermont and Connecticut are mentioned with doubt. It is said to be common on the lower parts of Cape Cod and Cape Ann, and is very abundant on Salt Island, near Gloucester.

It thus having been adventive on our northeastern coast for at least somewhat over sixty or more, probably seventy-five, years (since it is mentioned by Mrs. Sheppard in the Transactions of the Literary and Historical Society of Quebec, I., p. 193, 1829), it is interesting to note the fact that a new variety has apparently evolved in this country, so different from any known to exist in the old world that Dr. Binney described it in 1837 as a new species under the name *Helix subglobosa.* "The specimens first discovered by Dr. Binney were all of the plain greenish-yellow variety; and, though he could not fail to perceive their affinity to the *H. hortensis*, he thought he discovered differences enough to entitle them to a specific distinction, and therefore described them under the name of *H. subglobosa.* But numerous specimens have since been brought from the same vicinity, bearing all the various zones of the European specimens."

Perhaps a new locality, or one not generally known, is a small, quite inaccessible islet in Casco Bay called 'the Brown Cow,' between Portland and Harpswell. We found them in abundance over ten or fifteen years ago, and again in the summer of 1895. As stated by Binney, we also found their habits entirely different from those of *H. albolabris* and *alternata*, in crawling up the stems and over the leaves of tall plants, so that they have retained unaltered this habit of their European ancestors. The greenish-yellow variety *subglobosa* greatly outnumber the banded variety. Like other introduced species, they are much more prolific and numerous in individuals than the native species.

The other omission is the farther history of the case of the introduction, briefly referred to by Mr. Kew, 'a few years ago,' of *Helix nemoralis* from Europe into Lexington, Va., which is given by Prof. T. D. A. Cockerell in *Nature* for February 27, 1890, when he remarks: "Under the new conditions it varied more than I have ever known it to do elsewhere, and up to the present date 125 varieties have been discovered there. *Of these, no less than sixty-seven are new, and unknown in Europe, the native country of the species!* The variation is in the direction of division of the bands.

The facts collected in this little volume by Mr. Kew would seem, then, to be a necessary preliminary to a study of the varieties set up in immigrant species, and this will throw much light on the general question of the origin of species, the primary factors in the evolution of such forms being migration, exposure to new climatic conditions, and geographical isolation. These would seem to be sufficiently efficient and apparent causes of variation, without calling in, in such cases, the aid of natural selection.

A. S. PACKARD.

Laboratory Manual of Inorganic Preparations, by H. T. VULTÉ, Ph. D., F. C. S., Professor of Chemistry in Barnard College and assistant in Chemistry at the School of Mines, Columbia College, N. Y., and GEORGE M. S. NEUSTADT. New York, G. G. Peck. 1895.

There can be no doubt that a carefully pre-prepared manual of Inorganic Preparation is desirable. This book is not carefully prepared. The authors in their preface state that this book is compiled from the works of Erdmann and Fresenius and from various chemical journals. The articles translated from Erdmann are good, for Erdmann tested the methods before recommending them. Through a careless blunder in the translations of Erdmann's instructions for making iodine pentoxide from iodine and nitric acid, the student is told to use '158 c. e. of water and nitric acid.' Erdmann says 'anhydrous nitric acid.' Every chemist knows that unless the nitric acid is anhydrous, it does not yield iodine pentoxide.

On page 123 the author states that in distilling nitric acid at 121° an acid of the composition $2HNO_3+H_2O$ distills over. Of course, the acid HNO_3+2H_2O is meant. The abstracts of some of the articles from chemical journals are very carelessly written. On page 129 is an abstract entitled 'Pure Phosphoric Acid from Sodium Phosphite.' ('Phosphate,' of course,

is meant, as two pages further on an abstract on Calcium Phosphide is printed 'Phosphite,' but these are mere printer's errors; the book is full of such.) In the directions no reference is made to a filtration or other mode of separation of phosphoric acid formed from the by-product. The same criticism applies to the next method, 'Phosphoric acid from calcium phosphate,' though both the original articles mention the modes of separation, and careful attention to details is necessary in a laboratory manual.

On page 174 is an abstract of an article by E. J. Maumené, entitled 'Chydrazaïne or Protoxide of Ammonia.' The attention of the present writer was attracted by the statement at the end of the abstract, that 'on evaporating Chydrazaïne nitrate, nitric acid, nitrogen peroxide, nitrogen and a compound having the composition N_2H_2 are evolved.'

Suprised at finding the long-sought-for diimide as a by-product in a preparation for college students, the original article was consulted. Maumené is responsible for diimide and chydrazäine, and this is not the place to offer any further criticism of his work than to call the attention of the authors to the fact that the existence of chydrazäine has not been confirmed. Maumené uses a solution of potassium permanganate and sulphuric acid. He says, 'je les versais doucement dans une dissolution faite à l'avance de 111 grammes ammonium oxalate róel, cést a dire $111 \times \frac{78.86}{62} = 141.2$ sel cristallisé bien sec; le mélange était fait avec soin dans mon mélangeur; nécessaire en pareil cas.' The authors abstract this in these words. "A solution of potassium per maganate (158 grams) and sulphuric acid (40 grams SO_3) is added to dried crystallized ammonium oxalate (141.2 grams), the whole well mixed." Comment is unnecessary.

If this review be deemed harsh, the writer pleads that no one should publish a laboratory manual of preparations without knowing that the preparation of all substances described is not too difficult for students, and that the directions given are good and clear. By careful revision and excision, the authors can make their manual very valuable, as it contains an abundance of excellent matter.

E. RENOUF.

A Handbook of Industrial Organic Chemistry. By SAMUEL P. SADTLER, PH. D., F. C. S. 2d Edition, revised and enlarged. Philadelphia, J. B. Lippincott Co. 1895. 8vo., pp. 537.

That a second edition of this work should be called for within four years after the first appeared is evidence that the book has met general approval and satisfies the requirements it was intended to fill. The dearth of works of this class in the English language has been felt by instructors of technical chemistry for a long time, and consequently this volume, enlarged and improved and brought up to date, will be received with pleasure by every teacher of the subject. The chemical manufacturer and general reader will also find this an excellent work, neither too brief in its treatment of the several subjects, nor too abstruse in dealing with the minor details of processes or apparatus, and happily within the reach of modest pocket books.

There is no change in the manner or order of treatment of the various industries from that adopted in the first edition, but numerous additions and corrections have been made in the text. The bibliographical lists at the close o[f] the several chapters have been entirely revised, added to and brought up to the present time. This feature of the book is one of its most valuable points, since it places at the disposal of the reader a very complete list of works on any of these industries, should he desire more detailed accounts of processes or apparatus, thus saving him hours of laborious search through library or publishers' catalogues.

The numerous tables of statistics have been corrected and increased with the latest data obtainable and add much to the value of the book. In the appendix new tables showing the chemical and physical constants of oils, fats and waxes have been added.

The schematic tables of the various processes, scattered through the book are a great assistance to the reader, by showing at a glance the connections between different parts of the processes and also aiding to refresh the memory in reviewing the work.

The subjects treated are briefly: Petroleum and Mineral Oils, Fats and Fatty Oils, Essential Oils, Resins, Cane Sugar Industry, Starch and

its alteration Products, Fermentation Industries, Milk, Textile Fibres of Vegetable and Animal Origin, Animal Tissues and their Products, Destructive Distillation, Artificial Coloring Matters, Natural Dyes, Bleaching, Dyeing and Textile Printing. A very complete index adds to the convenience and worth of the book. The print is excellent, and numerous illustrations are distributed through the text. It is, as its name indicates, a 'handbook,' in which the various subjects are concisely and clearly explained, important topics being quite fully considered, while details of less importance, which often become so confusing and wearying to the student or general reader, are but slightly touched upon or entirely omitted. It is presumed that the reader who wishes minute and extended descriptions will look for them in the larger works or special literature bearing on the particular point in question.

This book presents, to a greater extent than any other work on the subject, processes and apparatus employed in America and hence will find favor with American readers. A translation which has appeared in German demonstrates, however, that it is also appreciated on the other side of the Atlantic.

It is to be hoped that a companion volume dealing with the inorganic side of technical chemistry may soon appear.

Frank H. Thorp.

SCIENTIFIC JOURNALS.

THE AUK, JANUARY.

With the present number '*The Auk*' enters upon its thirteenth year of publication as a quarterly journal of Ornithology, and the official organ of the American Ornithologists' Union. The first article is a memorial sketch of the late George N. Lawrence, of New York City, by D. G. Elliot. Mr. Lawrence died in January, 1895, in the ninetieth year of his age, being the last of the links connecting the present generation of ornithologists with the Audubonian period. He was the last also of the great trio of ornithologists—Cassin, Baird and Lawrence—who from the middle of the century onward laid anew the foundations of American ornithology. For a period of over fifty years Lawrence published almost continously on American birds, more especially on those of the West Indies, Central and South America, on which he was everywhere recognized as a leading authority. Mr. Elliot, from long personal acquaintance with Mr. Lawrence, was well fitted to unfold the tale of his simple life, which he has here done with rare felicity. An excellent portrait of Mr. Lawrence forms a fitting frontispiece to the number.

Mr. Frank M. Chapman, in an article on 'The Standing of *Ardetta neoxena*,' illustrated with a colored plate, gives the technical history of a rare and peculiarly interesting Heron, described about ten years since from a specimen taken in the Florida Everglades, but now known from about fifteen specimens, of which seven have been taken at Toronto, Canada, one each in Michigan and Wisconsin, and the rest in Southern Florida. D. G. Elliot describes two new Ptarmigans from the Aleutian Islands, A. W. Anthony, a new woodpecker from California, Gerrit S. Miller, Jr., a new jay from Mexico, and William Brewster, a new warbler and sparrow from North America. George H. Mackay writes of the Colony of Terns that still, thanks to careful protection, have their home on Muskeget Island, Massachusetts; L. Belding gives a rendering in musical notation of twelve songs of the meadow lark; and Miss Florence A Merriam writes at length on the habits of the Phainopepla in California. Other leading articles treat of the Pine Grosbeak, of an important factor in the study of Western bird life, and of the Thirteenth Congress of the American Ornithologists' Union, held in Washington, November 11–14, 1895. Some fifteen pages are devoted to 'General Notes,' under which are grouped some thirty short articles relating to the occurrence or habits of as many little known birds, while nearly twenty pages are devoted to reviews of current ornithological literature. There are also several pages devoted to obituaries and to various items of ornithological news.

THE AMERICAN GEOLOGIST, FEBRUARY.

Notes on the Geology of Eastern California: By H. W. Fairbanks. This part of the Great Basin, on account of its desert character and re-

moteness, has been little explored geologically; the present paper contains in part data obtained by the author during five months in 1895. The formations represented are divided into sedimentary and igneous, the former of which includes two distinct classes: (1) a metamorphic series, ranging in age from Cambrian through the Triassic, and (2) the unaltered Tertiary and Quaternary beds. The igneous rocks are granitic and volcanic; the former occur frequently as intrusions in the metamorphic series, and the latter consist of tuffs, liparites, andesites and basalts.

The Association of the Gasteropod Genus Cyclora with Phosphate of Lime Deposits: By A. M. MILLER. Several specimens of phosphate rock examined showed numerous shells of *Cyclora*. The analysis of the rocks as a whole gave varying percentages of P_2O_5 and $Ca_3\,(PO_4)_2$, while analyses of the *Cyclora* casts showed them to contain a much larger amount of these compounds. In one case 89 per cent. of the material of the casts was found to consist of these compounds.

The Buchanan Gravels: An Interglacial Deposit in Buchanan County, Iowa: By SAMUEL CALVIN. These gravels in their typical exposures form beds ten to fifteen feet in thickness, lying above the Kansan drift and below the Iowan. The contrast between the hard undecayed boulders of the Iowan drift and the decayed boulders of the Buchanan gravels and Kansan drift is striking. These gravels are made up of materials derived from the older drift and were probably laid down in water immediately behind the retreating edge of the Kansan.

Lacroix' Axial Goniometer: By N. H. WINCHELL. This paper describes and figures a comparatively simple apparatus for easily measuring the optical angle of a mineral; it can be adjusted to any microscope, being inserted in the top of the body tube, and gives the optical angle measured in air.

Phenomena of Falling Meteorites: By O. C. FARRINGTON. The author discusses the explosions of meteorites and the sounds which accompany the fall of these bodies. Evidence is given which shows that meteorites sometimes do explode, producing marked detonations.

Philadelphia Meeting of the Geological Society of America: By WARREN UPHAM. An account of this meeting is given, together with abstracts of all the papers presented and also abstracts of the discussions following the papers.

Under 'Editorial Comment' notice is made of Prof. James Hall's gold medals, of the Transvaal gold region, and of the geological map of Europe prepared by the International Congress of Geologists. Under 'Personal and Scientific News' abstracts are given of geological papers presented at recent meetings of various scientific societies.

SOCIETIES AND ACADEMIES.

THE SCIENTIFIC ASSOCIATION OF THE JOHNS HOPKINS UNIVERSITY, DECEMBER 19.

ONE hundred and twenty-third regular meeting, December 19, 1895. President Remsen in the chair.

The following papers were presented and read:

1. *Theories of Color Sensation and of the Perception of Sound:* By W. J. MATHER.

Mr. Mather gave a brief review of the older theories of color perception, followed by a careful discussion of the present state of our knowledge of this suject. He dwelt especially upon the theories of Mrs. Franklin.

2. *Recent Work on Impregnation in Flowering Plants:* By J. E. HUMPHREY.

Mr. Humphrey showed that until about four years ago impregnation in flowering plants was known to take place only by the growth of the pollen tube across the cavity of the ovary and through the micropyle left by the coats of the ovule. In 1891 Treub described impregnation in Casuarina, the Australian iron-wood, by the downward growth of the pollen-tube through the tissue of the ovary to the chalaza, or stalk of the ovule, and its upward growth through the body of the ovule to the egg-cell. In 1894 Miss Benson found the same thing to occur in several English catkin-bearing plants, the hornbeam, the alder, the hazel, etc.

Nawaschin has just published the results of his studies of the white birch, which agrees closely with the alder. In attempting to ex-

plain chalazal impregnation, he points out that the entire course of the pollen-tube of the Gymnosperms is through tissue. He thinks that in the primitive Angiosperms, the descendants of the Gymnosperms, the tube has not yet acquired the ability to grow across open spaces, and therefore takes the indirect route which enables it to make its whole course through tissue. He also announces that the elm constitutes an intermediate form between those with chalazal and those with the micropylar impregnation.

Much work on this line is yet to be done, which may throw light on relationships among flowering plants.

On motion the meeting adjourned.

JANUARY 23.

One hundred and twenty-fourth regular meeting, January 23, 1896. President Remsen in the chair.

The following papers were presented and read:

1. *The Temperature of the Earth's Interior:* By G. K. Gilbert.

The speaker first pointed out the difficulty attending any investigation of the earth's interior, and stated that in the present condition of physical science all estimates of interior temperature are necessarily founded on questionable postulates. He then gave the results of a series of computations of the average temperature, each starting with a group of postulates.

2. *The Effect of Pressure on the Wave-Lengths of Lines in the Arc-Spectra of Certain Elements:* By J. F. Mohler.

Mr. Mohler first pointed out that these wave-lengths had been considered as constants, and that it had even been proposed to use them as fundamental standards of length. This was followed by a detailed account of a series of experiments carried on in the Physical Laboratory of the Johns Hopkins University, which clearly establish the fact that these wave-lengths vary with the pressure. Pressures as high as twelve atmospheres were used. Diagrams were exhibited showing the results of the investigations.

The following papers of research were then presented and read by title:

1. *On Infinite Products:* By A. S. Chessin. (University Circulars: J. H. U.)

2. *Additional Note on Divergent Series:* By A. S. Chessin. (Bull. Am. Math. Society.)

On motion the meeting adjourned.

Chas. Lane Poor, *Secretary*.

BOSTON SOCIETY OF NATURAL HISTORY.

The Society met January 1st, forty-three persons present.

Prof. W. O. Crosby and Mr. A. W. Grabau showed that the chief deposits of modified drift in and about the Boston Basin could be referred to a connected chain of glacial lakes along the southern and western borders of the basin. These lakes existed between the receding margin of the ice sheet and the watersheds of the streams tributary to Boston Harbor, and, after the manner of lakes of this class, they were, through the continued recession of the ice margin, somewhat migratory in character and subject to great variations in outline, area, and level. During the period of the maximum and most interesting development of these lakes, the general trend of the ice margin was east-west along the southern border of the basin and north and northwest across the western end of the basin from the western end of the Blue Hills to the highland of Weston and Waltham; the ice, in accordance with the well established principles governing the motion of an ice sheet, having lingered on the depressed areas of the Boston Basin and Boston Harbor after it had disappeared from the relatively high land forming the western border of this great trough.

Along the south side of the basin, in Hingham, Weymouth, Braintree, Randolph, and Quincy, was formed Lake Bouvé (named in honor of Mr. T. T. Bouvé, a former President of the Boston Society of Natural History), some twelve miles in length. Its different levels, as determined by successive outlets, first south into North River and later east into Cohasset Harbor, were approximately 140 feet (Liberty Plain), 70 feet (Glad Tidings Plain), and 50 feet (Lower Plain). Other glacial lakes were formed in the upper basins of the Neponset and Charles Rivers. At their highest levels (240 to 300 feet) these were independent and tributary, respectively, to the Taunton and Blackstone Rivers. But at the level of 200 feet they were confluent and had a common outlet into the

valley of Taunton River. Still later an outlet was opened eastward along the south side of the Blue Hills into Lake Bouvé at a height of about 160 feet. The plains formed during this stage of the Charles-Neponset Lake extend eastward across Wellesley and Needham into Newton and West Roxbury, and northward across the broad water-parting (now occupied by Lake Cochituate) between the Charles and Sudbury Rivers, and thence, apparently, down the valley of the Sudbury and Concord Rivers into Billerica.

The western edge of the great angle or lobe of the ice sheet naturally receded eastward more rapidly than the southern edge receded northward, and so it happened that the ice continued to form a solid barrier across Boston Harbor after it had disappeared from all the country between the Blue Hills and Arlington Heights. The drainage of the Neponset and Charles Basins thus eventually became tributary to Lake Bouvé along the north side of the Blue Hills, at the height, first, of Glad Tidings Plain, and, later, of Lower Plain. Plains of these heights have an extensive development in the lower valleys of the Charles and Neponset Rivers, across the site of Boston, and also in the upper valley of the Mystic River, outlining a body of standing water, which it is proposed to call Lake Shawmut, from the Indian name for Boston.

When the front of the ice sheet receded from the high land terminating in Fox Hill, northeast of Billerica Center, the drainage of the Concord, Merrimac, and Shawsheen Valleys probably found an outlet southeastward, along the course of the Boston and Lowell Railroad and the old Middlesex Canal, into the valley of the Mystic, and thence through Lake Shawmut and Lake Bouvé to Cohasset Harbor. In the glacial lake thus conditioned north of the Mystic water-parting were deposited the extensive plains having a normal height of about 100 feet, which stretch across Wilmington, northern Billerica, Tewksbury, and Lowell. It is very probable, also, that later a part of this northern drainage found its way southward through the valleys of the Malden and Saugus Rivers.

SAMUEL HENSHAW,
Secretary.

NEW YORK ACADEMY OF SCIENCES, BIOLOGICAL SECTION. JANUARY 13.

THE papers presented were:

G. S. HUNTINGTON, '*On The Visceral Anatomy of the Edentates.*' The characters of the brain, alimentary, respiratory and genito-urinary tracts were especially considered. The following forms were discussed: *Myrmecophaga jubata, Tamandua bivittata, Arctopithecus didactylus, Dasypus sexcinctus, Tatusia novemcincta, Manis longicandata.* In the brain characters the following features were considered: the transverse frontal sulcus, the great longitudinal fissure, and the absence of a distinct Sylvian fissure. In the alimentary tract the Sloths are to be sharply separated from the remaining groups, the stomach structure with its pyloric gizzard notably aberrant: the ileo-colic junction is traced throughout the Edentates in a well marked series of transitional forms.

O. S. STRONG, '*On the Use of Formalin in Injecting Media.*' The paper made especial note of the advantages posessed by this preservative in injecting in brain in situ. Formalin (40% formaldelyde) diluted with an equal volume of water is injected into the cephalic vessels until it runs from the cut jugulars. After a few minutes the same quantity is again injected, and once or twice again after an elapse of fifteen to twenty minutes. The brain is then removed and will be found to be completely fixed throughout. The swelling usually noticed in formalin hardened brains does not appear to take place when this method is employed. Besides the many general advantages of fixing brains by injection, formalin has the especial merit of giving them the best consistency for microscopic work, and further, such brains are available subsequently for the Golgi and Weigert methods, as well as possibly for cytological methods. Formalin also has the advantage that it can be used, as above, stronger than is necessary for fixation and thus allowance made for its dilution when permeating the tissue. When only the Golgi method is to be used, an equal volume of a 10% solution of potassium bichromate may be added to the formalin instead of water. Pieces may be subsequently removed, hardened further in formalin-bichromate and impregnated with silver.

BASHFORD DEAN, '*On the Supposed Kinship of the Paleospondylus.*' A favorably preserved specimen of this interesting fossil, received by the writer from Wm. T. Kinnear of Forss, Scotland, appears to warrant the belief that this lamprey-like form was possessed of paired fins, a character decidedly adverse to the now widely accepted view of Marsipobranchian affinities. The structure referred to consists of a series of transversely directed rays, arising from the region of the postoccipital plates of Traquair. From this peculiar character, as well as from many unlamprey-like features of the fossil, it would appear accordingly that the kinship of the Paleospondylus is as yet by no means definitely determined.

C. L. BRISTOL,
Secretary of Section.

JANUARY 13, 1896.

SECTION OF GEOLOGY AND MINERALOGY.

AT the meeting of the section of Geology and Mineralogy of the New York Academy of Sciences held January 20th, Prof. J. J. Stevenson in the chair, the following papers were presented:

The first, by E. O. Hovey, described the new and remarkably fine specimens of rare minerals recently discovered by Mr. Niven in the upper part of New York City. A doubly terminated tourmaline, 9½ inches long by 4½ inch diameter, was shown, and also unusually large samples of xenotime and monazite. The largest xenotime was ⅜ of an inch in diameter, the monazite was about ⅝ of an inch on the long edge. Fuller details regarding the crystallography appear in the Bulletin of the American Museum of Natural History of recent date. The specimens are now in the museum.

The second paper was by J. F. Kemp and T. G. White, and brought out the results of further exploration in the Adirondacks, the Lake Champlain Valley and the Green Mountains as regards the distribution of the trap dikes, well known from that region. One was cited on Mount McIntyre about 4,000 feet above tide, and others from various interior points in the Adirondacks. Microscopic study shows that they are in instances both camptonites and fourchites. This modifies the previous experience of Kemp and Marsters, who had found only diabase dikes in the Archean rocks. A great number of dikes were mentioned from the shores of Willsboro' Bay, on the New York side; one dike of camptonite was described from the granite quarries near Barre, Vt., and one from the Eustis pyrites mine, near Sherbrooke, Que. These outlying dikes materially extend the area in which they had been previously known. Very curious exposures were also described as having been recently uncovered in the Willard's Ledge quarries at Burlington, Vt. The paper concluded with some reflections on the petrology of the dikes. It will appear in full in the Transactions of the Academy.

The paper was followed by one by W. D. Matthew describing the metamorphism of Triassic coals at Egypt, N. C., by the intrusion of diabase dikes. Beginning with samples of coal at a distance of seventy feet from the dike it was shown that there is a progressive loss of volatile hydro-carbons as the igneous rock is approached, and that the bituminous coal passes into anthracite and this into prismatic coke next the dike. Geological sections and tables of analyses were shown. Attention was called to the fact that similar phenomena have been previously described from Virginia, but not from Egypt, N. C. The paper will appear in full in the Transactions of the Academy.

The last paper was by J. J. Stevenson on 'The Cerrillos Coal Fields near Santa Fé, N. M.' Prof. Stevenson brought out, by means of geological sections, that there were four coal seams contained between two laccolites of trachyte which had spread sidewise between the beds for nearly a mile from the parent dike or neck. In the topmost seam next the neck the coal was a graphitic anthracite passing, as the neck was left behind, into true anthracite, which graduated into semi-bituminous, and this into bituminous coking coal. The nearness of the laccolites appeared to exercise but little influence on the seams that were immediately over or under them, but the metamorphic change was due to the dike. The middle seam, which is at a maximum distance from the two laccolites, is bituminous coal throughout, so far as known, but it has not been worked near the dike. The speaker also referred to the change in our former ideas regarding the geology of

the region, in that the intruded rocks have proved to be in two separate laccolites, where they were formerly thought to be in innumerable dikes. The paper was discussed by J. F. Kemp, who referred to the fact that the metamorphic changes were doubtless due to vapors or heated waters set in circulation by the dike; to which the speaker assented. The paper will appear in full in the Transactions.

J. F. KEMP,
Secretary.

MEETING OF THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE regular monthly meeting of the New York Section of the American Chemical Society was held at the College of the City of New York, 23d street and Lexington avenue, on Friday evening, January 10th.

Mr. G. C. Henning, M. E., delegate for the American Society of Mechanical Engineers, reviewed the 'Present Status of Iron and Steel Analysis,' calling attention to the discrepancies in some recent work of different chemists in determining the constituents of the same quality of steel, with special reference to carbon and phosphorus, and to the omission of the direct determination of iron, which he thinks conducive to overlooking such elements as titanium, tungsten and others, which are more often present than the usual iron analysis would indicate, as they are but infrequently determined directly.

He considers that the microscope has opened a field which marks a great advance in methods of determining the condition and quality of iron and steel, and thinks that chemical methods need great improvement to distinguish the conditions in which the carbon exists.

Mr. Rossi in discussing Mr. Henning's paper thought it would be very difficult, if not impossible, to recognize the different combinations of iron and carbon by chemical means, at least in the present state of chemical science, since there is so little outside of physical characteristics to distinguish them. In replying to these remarks, Mr. Henning said that several steel and iron companies in this country have already established very complete micrographic laboratories, where in three hours an accurate determination of the condition of any specimen of the daily output may be secured.

Papers were were read by Mr. G. C. Stone on 'The Probable Formation of Permanganates by Direct Combustion of Manganese' and 'Remarks on the Volhard Method of Determining Manganese;' by Dr. E. R. Squibb, on the 'Manufacture of Acetone and Acetone-Chloroform from Acetic Acid,' in which he reviewed the history of acetone from its first mention to the present date, and by Mr. J. S. Stillwell on Highly Compressed Gases.'

Dr. Squibbs showed that owing to the quotation, in standard works of reference, of erroneous results obtained by earlier experimenters, the progress of the manufacture of acetone had, for many years, been obstructed, and consequently the successful manufacture of chloroform from acetone had been correspondingly delayed.

Mr. Stillwell discussed the causes of explosion of cylinders of compressed gases with especial reference to those explosions which were supposed to result from the chemical combination of the compressed gas (oxygen) with oil or grease used as lubricant, and carried into the cylinders. He maintains that a temperature of 400° F. is required to produce such chemical combination, and that this temperature is never reached under normal working conditions.

DURAND WOODMAN,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 41st meeting of this Society, held in Washington, D. C., January 22d, two communications were presented, one by Mr. Arthur Keith, on the 'Crystalline Groups of the Southern Appalachians,' and the other by Prof. Chas. R. Van Hise, of the University of Wisconsin and the U. S. Geological Survey, on 'Primary and Secondary Structure and the Forces that Produced them.'

Mr. Keith described seven classes of formations, in which no sedimentary origin appeared. These comprised mica, gneiss and schist of three types, granite of five types, diorite of two types, gabbros of two types, peridotite and pyroxenite of five types, basalt and diabase of five types, andesite of two types, quartz porphyry and rhyolite of four types.

These formations occupy long narrow belts, comparable in extent with the sedimentary rocks, and belts of plutonic rocks alternate with volcanic rocks. Attention was called to the prevalence and attitudes of the schistose plane, due to deformation, and to the similar deformation of sediments and crystallines in the same area. The whole series of stratigraphic and structural results in sediments and crystallines was classified as part of the Appalachian system.

Prof. Van Hise discussed the relations of secondary structures to the forces that produced them, and it was concluded that there have been two entirely different structures described under the term 'cleavage.' Following the English geologists, it was held that one of these structures develops normal to the pressure in a deep-seated zone of rock flow, and that this ought properly to be called 'cleavage.' Following Becker it was held that there have often developed two intersecting structures on shearing planes in the zone of fracture. For this structure the term 'fissility' was proposed.

Mr. Becker, in discussing Prof. Van. Hise's paper, expressed himself as certain that true cleavages as well as ruptures are produced at large angles (not necessarily 45°) to the line of force. He regards the existence of such cleavages as well established, both by experiment and by theory. In his opinion, no adequate theoretical or experimental basis exists for asserting that cleavage is normal to force, and field observations on slates leave the exact direction of force to inference.

The communication, which was listened to with much interest, was illustrated by a number of diagrams.

On account of the importance of the subject it was proposed to invite Prof. Van Hise to give the Society a more extended presentation of it at the meeting to be held January 29th.

W. F. Morsell.

INDIANA ACADEMY OF SCIENCE.

The eleventh annual meeting of the Indiana Academy of Science was held at Indianapolis, December 27–28, 1895.

The meeting was quite largely attended and much interest was manifested. More than forty new names were added to our list of members.

The address of the retiring President, Mr. Amos W. Butler, on 'Indiana: A Century of Changes in the Aspects of Nature,' was intensely interesting and very instructive.

The papers were numerous and most of them of importance to the scientific work of the State.

The report of the Biological Survey on Turkey Lake deserves special mention. It indicated a great amount of work and will be productive of much good in creating a deeper interest in such work. Many papers ought to be mentioned, but space will not permit.

The officers for the next year are as follows: President, Stanley Coulter, Purdue University; Vice-President, Thomas C. Gray, Rose Polytechnic; Secretary, John S. Wright, Indianapolis; Assistant Secretary, A. J. Bigney, Mooles Hill College; Treasurer, W. P. Shannon, Greensburg.

The Spring meeting will probably be held in connection with the Ohio Academy, near the State line.

A. J. Bigney,
Assistant Secretary.

NEW BOOKS.

Anleitung zur Mikrochemischen Analyse. H. Behrens. Hamburg & Leipzig, Leopold Voss. 1896. Pp. xiii+108. M. 5.

Handbook to the British Mammalia. R. Lydekker. London, W. H. Allen & Co. Limited. 1895. Pp. xiii+339.

The Elements of Physics, Vol. I., Mechanics and Heat. Edward L. Nichols and William S. Franklin. New York and London, Macmillan & Co. 1896. Pp. xi+228. $50.

The Story of the Solar System. G. F. Chambers. New York, D. Appleton & Co. 1896. Pp. 181. 40 cents.

Life, Letters and Works of Louis Agassiz. Jules Marcou. New York and London. 1896. Vol. I., pp. ix + 303; Vol. II., pp. x + 318. $4.00.

Old Faiths and New Facts. William W. Kensley. New York, D. Appleton & Co. 1896. Pp. 345. $1.50.

Studies of Childhood. James Sully. New York, D. Appleton & Co. 1896. Pp. viii + 527. $2.50.